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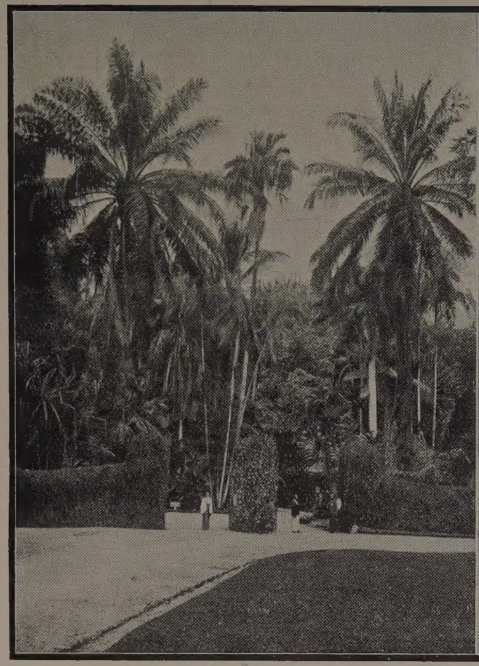
AGRICULTURAL EDUCATION.

The opening of the School of Tropical Agriculture which takes place this month is an occasion that may be looked back upon in time to come as an important milestone in the progress of tropical agriculture in the East. The opportunity should not therefore be allowed to pass without recalling the names of members of the Board of Agriculture and others whose labours have contributed to the ultimate establishment of the school. It was DR. WILLIS, Director of the Royal Botanic Gardens, who first suggested the school should be at Peradeniya; or rather "in the neighbourhood of Kandy" in order to be near the Experiment "Garden" (now the Experiment Station) which it was hoped to open at Peradeniya. MR. JOHN FERGUSON, a member of the Commission appointed by SIR WEST RIDGEWAY in 1900 to consider the question of establishing a Department of Agriculture, supported DR. WILLIS's suggestion, which was subsequently approved by the Government. In 1909 MR. JOHN FERGUSON read a paper on Agricultural Education for which he was personally thanked by the Governor, SIR HENRY MCCALLUM. Other papers and memoranda on the subject were contributed by MR. JOHN HARWARD, Director of Education, DR. WILLIS, DR. LOCK, MR. E. EVANS and MR. W. A. de SILVA. Another prominent member of the Board, DR. H. M. FERNANDO, was on the committee appointed by the GOVERNOR in 1909 to consider and report upon proposals for establishing agricultural training in Ceylon. There has however been one member more conspicuously identified with Agricultural Education than

anyone else in or out of the Society, namely MR. C. DRIEBERG, the Secretary, and Assistant Editor of this Journal, who is the Vice-Principal of the new school. MR. DRIEBERG was head of the Agricultural School in Colombo which was closed in 1901 when the Peradeniya scheme took shape. To that school we trace the germ of the present one and it must be particularly gratifying to MR. DRIEBERG to witness after 15 years his labours bearing renewed fruit.

One soweth and another reapeth. Our late Governor, SIR ROBERT CHALMERS, who left our shores last month, brought to a head the project of his predecessors by directing that plans for the school should be prepared and its establishment proceeded with. This has been done in a time of war and retrenchment and consequently in the most economical way possible. For the accommodation of boarders, 30 in number, an empty bungalow belonging to the Government has been occupied for one hostel and another bungalow has been leased for a second. A temporary building 58 feet by 20 feet has been erected in the Royal Botanic Gardens for the principal class-room. There is a smaller building for a second class-room. Furniture for the hostels and class-rooms has been made by prison labour from wood supplied by the Forest Department. No excessive outlay has therefore been incurred on buildings and equipment. Expenditure connected with the teaching staff will be met to some extent by tuition fees of the students.

Our circumstances are upretentious, our equipment inexpensive, befitting the time and the future about which we have no delusions. The school at present is popular but this popularity may perhaps wane if ex-students are disappointed in their expectations of obtaining immediate employment afterwards. Some years must elapse before the true place of the school in the economic welfare of the island is clearly understood and appreciated. But that this will eventually take place we have no misgivings whatever. Providing some professional equipment for young men destined for the land is, however, only part of the objects of the School. Teachers for the Government vernacular schools are to take the course in order to qualify them for teaching agri-



Photos by H. F. Macmillan.

ENTRANCE TO THE ROYAL BOTANIC GARDENS, PERADENIYA.

MAIN CENTRAL DRIVE, ROYAL BOTANIC GARDENS, PERADENIYA.

culture. At first only six are attending but this number will probably be increased annually till all who pass through the Training College will be sent to Peradeniya before being drafted out to the villages. Agriculture we hope may then become one of the subjects of the code. Boys whose lives are to be spent on the land, the lot of the vast majority, will then be taught something of their mother earth and her products which are their living, beyond what they are able to learn by uneducated observation. When, as will happen in the course of time, the 1,600 or 1,700 teachers on the staff of the Government village schools will all have been to Peradeniya we shall have created automatically, in conjunction with the School Gardens already established, an organization for enabling the problems of village agriculture largely to solve themselves. Of course all teachers will not become competent agriculturists; there will always be some for whom rural pursuits possess no attractions. On the other hand there will be many who, having had their interests aroused, will follow up their studies and become for their people enthusiastic leaders along more enlightened paths. It will be seen what great possibilities this system of agricultural education possesses for Ceylon.

In another direction the School may be expected to operate for good. One of our problems at Peradeniya is to make known to and understood by the people the results of our work. Take for example the new system of water control to paddy fields now under trial at the Experiment Station. Paddy cultivators, for whom this might mean much, will remain—as to the majority of them—ignorant of these methods and of their results because they do not read our publications nor will they—or indeed can they—come and look at the crop growing and see for themselves. Students spending a year or more at Peradeniya will take away with them when they leave first-hand knowledge of the work of the Department, which will thus become linked up with all parts of the country. They will be acquainted with the activities of Peradeniya and with its personnel whom they will have come to regard not only as instructors but also we may hope as friends and advisers. This process of familiarizing the Department in all quarters of the island will have a reciprocal effect upon the Department itself by enabling it in an ever increasing degree to get into closer touch both with the planter and village cultivator and their needs.

R. N. L.

THE HOME OF THE SCHOOL OF TROPICAL AGRICULTURE.

A HISTORICAL SKETCH OF THE ROYAL BOTANIC GARDENS, PERADENIYA.

[*Illustrated—See frontispiece.*]

The history, as well as the reputation, of the Royal Botanic Gardens, Peradeniya, is fairly well known, but in view of another prominent milestone in its career being reached, namely, the School of Tropical Agriculture, a brief retrospective may not be uninteresting.

BOTANICAL ATTRACTIONS OF CEYLON.

Ceylon has long been regarded as an attractive and promising field for the botanist, no less so than for the enterprising planter, and early botanical expeditions from Europe may be traced back to the middle of the seventeenth century. About that period the Dutch East India Company engaged a MR. HERMANN, a well-known scientist of his time, to describe the plants and spices growing in the Island—a task beset with many difficulties in view of the fact that the interior was then practically impenetrable to Europeans. Nevertheless HERMANN succeeded in making an important herbarium collection comprising some 600 species. This nucleus, it may be mentioned, is now in the British Museum, London. HERMANN was followed at varying intervals by other distinguished botanists—BURMAN, THUNBERG, and KŒNIG, (names commemorated in well-known genera and species of plants) to mention only a few.

THE BEGINNING OF THE ROYAL BOTANIC GARDENS.

Soon after the arrival of the British in 1796, the importance of a properly established botanic garden, both for the study of the indigenous flora and for the introduction and acclimatisation of useful foreign plants, was recognised. In 1799 a site was chosen at Peliyagoda, afterwards found unsuitable; in 1810 another site was selected at Slave Island, and placed under the superintendence of MR. KERR, a trained horticulturist from Kew. He named it Kew, a name still in use in that locality. This, however, was not destined to be the "Kew of the East," though no doubt the commencement made there helped, when the stock was transferred to Peradeniya, to make the latter place worthy of this appellation. KERR secured the honourable title of "Royal Botanic Gardens" for his department, but the site of Colombo as well as one of 600 acres procured later at Kalutara proved unsuitable for its purpose.

DISCOVERY OF PERADENIYA BY MOON.

The honour of discovering Peradeniya was due to ALEXANDER MOON, who succeeded KERR in 1816. MOON was a zealous botanist and did much to enhance the knowledge of Ceylon botany. He published in 1824 his "Catalogue of Ceylon Plants," a volume containing a record of over 900 indigenous and a number of exotic plants.

EARLY BOTANIC PUBLICATIONS.

This book is of special interest as being the first publication giving specific names to Ceylon plants in accordance with the binomial system of

nomenclature invented by LINNÆUS. MOON was an indefatigable botanical collector, and the magnitude of his collections may be estimated from the fact that it took ten carts to remove them to Peradeniya, the journey doubtless occupying many days. It was in 1821 that MOON selected at Peradeniya the site, and formed the nucleus, of what was destined to become a botanical institution of world-renowned fame. MOON, like his predecessor, succumbed to fever, after an energetic career of nine years. His name has been commemorated in the genus *Moonia* (now *Chrysogonum*), whilst KERR's memory has been preserved by the well-known Japanese shrub *Kerria*.

PROGRESS OF BOTANICAL WORK.

Peradeniya henceforth became the centre of botanical activity, but in subsequent years it passed through many vicissitudes, as might be expected in a country where there is necessarily a somewhat frequent change of officials. In the twenty years following MOON's period no less than seven superintendents succeeded to the charge, none of them leaving, as far as the Gardens were concerned, a record of conspicuous service, due perhaps to circumstances beyond their control. At one time the Gardens, or such portions as were then under cultivation, were used as a market garden, the produce being sold in Kandy.

ARRIVAL OF DR. GARDNER, F.L.S.

In 1844 the Department may be said to have entered upon a new era of activity by the arrival of GARDNER. GARDNER was an enthusiastic traveller and collector, and already famous by his explorations in Brazil. His activity may be judged from the fact that he collected and dried about a thousand species when on a health trip to the Nilgiris. With but few facilities he travelled over a large portion of Ceylon, but his strenuous career was cut short by his untimely death at Nuwara Eliya, four years after his arrival in the Island. His name has been honoured in the genus *Gardneri* and in several species. This made the eighth superintendent in 24 years.

DR. THWAITES, F.R.S.

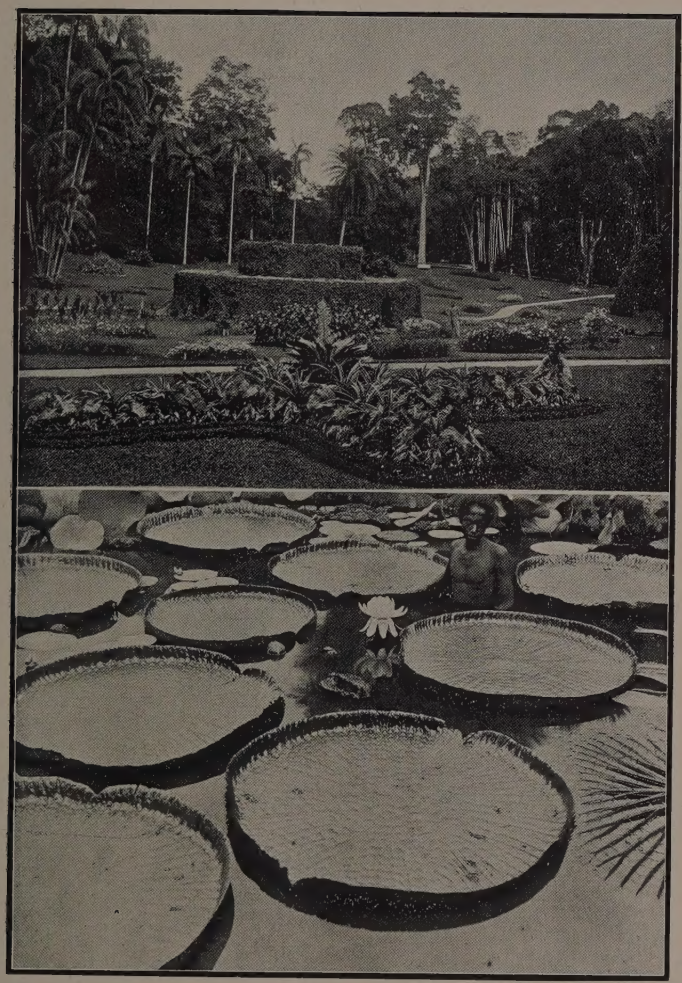
Succeeding GARDNER, Dr. THWAITES arrived early in 1850 to take up the duties of the post, which he worthily and uninterruptedly held for over 30 years, during which he never left the Island. THWAITES was an indefatigable worker and a distinguished botanist. He published among other works his ENUMERATIO PLANTARUM ZEYLANIÆ, a work entirely in Latin and rigidly technical. It was during his tenure that the branch garden at Hakgala was opened (1860), and that at Henaratgoda in 1876, the former for experimenting with Cinchona and other products suited to the higher elevations, and the latter (Henaratgoda) in the low-country for the first introduction of Hevea rubber in the East and for the experimental cultivation of low-country products. In 1868 the 2-storeyed building for the herbarium and library was opened, these being hitherto kept in a portion of the Director's bungalow—now the head offices. The designation of the post was altered in 1857 from Superintendent to Director. The algal genus *Thwaitesia* and the beautiful flowering epiphytic shrub *Kendrickia* were dedicated to THWAITES by his botanical friends in Europe. DR. THWAITES died in Kandy in 1882, and a cenotaph memorial was erected to his memory in 1885, in a prominent part of Peradeniya Gardens.

DR. TRIMEN, F.R.S.

DR. TRIMEN succeeded THWAITES in 1880, at a time of depression in the Colony owing to the coffee leaf disease, which finally resulted in the extermination of the coffee industry. It is undoubtedly to TRIMEN more than any one else that the present advanced state of knowledge of the Ceylon flora is due. A distinguished scientist and a man with a marvellous capacity for work, he was also a keen horticulturist. In contrast to his predecessors he devoted much energy to carrying out improvements in the Gardens, where he was wont to spend his early mornings and evenings designing improvements and making a personal study of the collections. He introduced new systems and new features, including the general labelling of trees, shrubs, &c., which practice, curiously enough, did not find favour with his predecessor. The opening up of the southern end of the Gardens, the commencement of the Students' Garden, and the Talipot avenue are among the features initiated by TRIMEN. He started the Museum at Peradeniya, opened a branch-garden at Anuradhapura in 1883, and another at Badulla in 1886, both of which he personally laid out. A facile and prolific writer, he was author of several important publications. He was for some time Editor of the JOURNAL OF BOTANY, to which and to similar publications he was a frequent and regular contributor. He had contributed no less than 50 papers to the Royal Society, of which he was a Fellow. He was a recognised authority on quinology, co-author of a standard work on MEDICAL PLANTS, author of FLOWERING PLANTS AND FERNS INDIGENOUS TO CEYLON, and HORTUS ZEYLANICUS. His *magnum opus*, however, was his FLORA OF CEYLON, a standard work and, according to SIR JOSEPH HOOKER, a model of what such compilations should be, it being "characterised by the critical insight and terse lucidity which always distinguished the author." DR. TRIMEN died in harness, in 1896, after only 15 years' service and a trying illness, his tragic death-bed being literally covered with manuscripts. It is regretted that no memorial has as yet been erected to his memory in the Gardens, which he loved so intensely and did so much to develop on utilitarian and scientific lines.

DR. WILLIS, F.L.S.

Following TRIMEN in 1896, DR. J. C. WILLIS took up the duties of Director with energy, and at a time when rubber was talked about as a likely product for the low-country. He succeeded in considerably increasing the staff of expert officers of the Department, securing the appointment of a mycologist, entomologist, scientific assistant (afterwards superseded by the post of assistant-director), two superintendents of experiment stations and a Government chemist. Gangoruwa estate was acquired in 1902 as an experiment station, and WILLIS foreshadowed its use for the training of students in tropical agriculture. In the same year an experiment garden was opened at Nuwara Eliya, and in 1904 a cotton experiment station at Mahailuppalama at the instance of the British Cotton Growing Association. The useful branch gardens at Badulla and Anuradhapura established by TRIMEN were, however, abolished. The School Gardens, under the superintendence of MR. C. DRIEBERG, were combined with the Department in 1901. The Ceylon Agricultural Society was inaugurated in 1904, with DR. WILLIS *exofficio* as Organising Vice-President. The Research laboratory was completed in 1900, and the new 2-storied building for the Botanical Museum and Herbarium in 1908.



Photos by H. F. Macmillan.

The top photograph shows a view in the Floriculture Section, with the Octagon Conservatory in the centre; the lower shows a good specimen of the Giant Water Lily (*Victoria regia*).

IN THE ROYAL BOTANIC GARDENS, PERADENIYA.

WILLIS published his useful book DICTIONARY OF FLOWERING PLANTS AND FERNS before coming to Ceylon, and while in office he brought out a general guide book to the Island and a book on tropical agriculture. His principal work was his monograph of the *Podostemmaceæ*, published in 1902. WILLIS began the publication of the Annals of the Royal Botanic Gardens in 1901, also the Circulars (now Bulletins) of the Department. In 1905 he met with an unfortunate accident whilst on circuit in the N.C. Province. He resigned in 1911, the post of Director of the Royal Botanic Gardens having been abolished, and afterwards went as Director of the Botanic Gardens, Rio de Janeiro, from which he retired in 1915.

MR. R. N. LYNE, F.L.S.

This is not the time to give MR. LYNE's biography, but it is essential for the purpose of this sketch to refer to his name in chronological order, as he is the first Director of Agriculture in Ceylon. A change to a more utilitarian policy for the Department had been decided upon by Government, as a result of prolonged deliberation inaugurated by SIR WEST RIDGEWAY in 1900, continued by SIR HENRY BLAKE, who founded the Ceylon Agricultural Society with a view to the better development of agriculture, and brought to a head by SIR HENRY MCCALLUM. As a result a Department of Agriculture was formed, and MR. LYNE was selected for the new post in 1912, arriving from Portuguese East Africa, where he relinquished a similar charge. He held previously the office of Director of Agriculture in Zanzibar, and was the author of two books on both these spheres of his former labours.

The reorganisation and expansion of the Royal Botanic Gardens Department into a Department of Agriculture was completed in 1913 by the formation of seven separate Divisions, each under a responsible and experienced chief with a considerable scope and freedom for independent action. These Divisions are: Mycology and Botany, Entomology, Botanic Gardens, Chemistry and Rubber Research, Experiment Stations, Low Country Products and School Gardens, and Agricultural Education. The result of this arrangement was definitely to apportion responsibility and to relieve the Director of much routine work. The re-organisation of his Department completed, LYNE proceeded to establish Trial grounds at Anuradhapura for dry zone crops and at Jaffna for tobacco, the latter under the management of an expert tobacco planter from America. Manurial experiment plots of coconuts were instituted at Chilaw, Negombo and other parts of the Island. The administration of the Co-operative Credit Societies Ordinance was transferred to the Department of Agriculture in 1913, MR. LYNE being appointed Registrar. In the same year the TROPICAL AGRICULTURIST, edited by LYNE, was purchased from MESSRS. A. M. & J. FERGUSON and became the property of the Ceylon Agricultural Society as its journal, the headquarters of the Society having been transferred to the Royal Botanic Gardens in the meantime. The publication of the Department, hitherto known as "circulars" became in 1912 *bulletins*. In 1913 the proposal for a College of Tropical Agriculture being established in Ceylon received concrete shape, and we may hope that the new school now inaugurated is a step in the direction of the ultimate establishment of this important project.

LANDSCAPE DEVELOPMENT.

Returning to the history more particularly of the Gardens, it is necessary to allude to the writer who was appointed from Kew as Curator in 1895.

From this date the development of the great natural advantages of the site of the Gardens received special attention, and it is proposed now to refer to some of the prominent changes that have been effected during that period.

THE MAIN CENTRAL DRIVE.

The Central Drive, now one of the features of Peradeniya, was then but a narrow track bordered by strips of struggling turf under the shade of overhanging trees. This was first taken in hand. Superfluous trees and all the shrubs, etc., along the front were removed in order to obtain a greater and more commanding width. The borders throughout their length were replanted with due regard to variety and quality of the plants employed, and the whole drive remade and levelled. The drive is now known as the glory of Peradeniya. (See illustration).

THE FERNERY.

Afterwards the Fernery was taken in hand, being re-constructed and considerably extended. By getting rid of some enormous specimens of Ficus and Canarium trees a commanding view (see illustration) has been gained from the Central Drive.

FLORICULTURE SECTION.

At that time the chief beauty of the Gardens consisted largely in their wildness. There was no attempt at floriculture except a few small beds round the plant-houses. Now there is an extensive and beautifully undulated Floricultural Section in a central part, which was formerly purposelessly occupied by a growth of common vegetation, decaying tree stumps and stone boulders. This has been converted into the most popular and most frequented part of the Gardens and has, it is believed, no rival in any botanic garden in the tropics, the plants used being nearly all selected tropical kinds grown in masses (see illustration). Breaks were made in the borders of the Central Drive in order to obtain glimpses of this new feature on one side, and of the extensive lawn on the other. The Great-lawn, which had been made chiefly by TRIMEN, was far from complete; several unsightly old trees had to be removed, irregularities reduced and the surface generally brought to the state of a lawn (see frontispiece).

THE ARBORETUM.

The work of improving the Arboretum, which was then mostly in a state of unbridled nature, was a long process and has only recently (1914) been brought to anything like completion by MR. T. H. PARSONS, who was appointed Curator on the promotion of the writer to Superintendent of the Division of Botanic Gardens in 1912. Twenty years ago it was difficult to find one's way about in, much less become properly acquainted with, the contents of this interesting and essential part of the Gardens. The most common trees were *Michelia*, *Cananga*, *Bombax* and wild varieties of Mango. Coconuts and arecanuts were numerously interspersed, many of them having the appearance of being self-sown. The task of cutting out the excessive vegetation, while retaining uninjured the desirable species, and of removing the unsightly and enormous tree stumps, was only satisfactorily accomplished after several years, the rule of cutting trees low down not having previously been enforced. The two vistas here, commanding peeps of distant hills, were first opened out in 1898 and re-opened and enlarged in 1914.

Photos by H. F. Macmillan.

TALIPOT PALM AVENUE
(*Corypha umbraculifera.*)

THE ROYAL PALM AVENUE.
(*Oreodoxa regia.*)

IN THE ROYAL BOTANIC GARDENS, PERADENIYA.

THE LAKE.

In 1904 what was formerly a deep pond, unfit for ornamental or useful purpose, was converted into a little lake by sloping away the banks and making a cutting round a group of trees and bamboos which thus at once formed a ready-made island; the earth obtained served for filling in the lake to a reasonable depth, rendering it fit for the growth of water plants, including the Giant Water-lily of Brazil and the Papyrus of the Nile, both recent introductions.

AVENUES AND THE GREAT CIRCLE.

The fine avenue of *Oreodoxia regia* (see illustration) was planted in 1898 and the road through it made in the following year. The *Brownea* avenue was planted in 1900 and interplanted with *Cassia multijuga* in 1904. An avenue of the beautiful *Lagerstrœmia* was planted in 1910 to separate the floricultural section from the fruit collection. The new row of Talipot palms, commencing near the orchid-house, was planted in 1907, while the Amherstia row flanking the approach to the Gardens on the Kandy side and the new Ficus row on the opposite side were planted in 1904 and 1914 respectively. What promises to become a unique avenue of the Double coconut palm, or Coco-de-mer *(Lodoicea Sechellarum)* was begun along the monument road in 1902, the nuts, obtained from Seychelles, being sown *in situ*. In 1906, after the first Rubber Exhibition was held on the Great Circle in the Gardens, a sum of Rs. 1,100 was used on levelling and improving that spacious lawn. The Spice Collection was begun in 1897 and considerably extended in 1914 by the levelling of the deep elephant ditch which formerly formed the Gardens boundary to the East. An illustrated guide book to the Gardens was published in 1905.

H. F. MACMILLAN.

PALM KERNEL CAKE AND HOME FARMING.

Rising prices of meat and milk, to which we are becoming painfully accustomed, reflect the difficulties of the farmer in obtaining fodder and feeding stuffs for his stock. The vagaries of the past season's harvests have thrown the dairy farmer and breeder more than ever back on supplementary and concentrated feeding stuffs to tide them over the winter months. For some years the greater available variety of ingredients for cakes and meals has steadied their prices to the farming community. Soya beans, for instance, have been a great boon, and a similar good turn is now being done by the greater supply of palm kernel cake being put on the market. The cakes, made from the milling refuse of palm kernels from West Africa, are steadily being produced more and more at home. As was recently pointed out in our columns, the bulk of the palm kernel trade was in German hands till war broke out. Energetic measures have since been taken to secure the rapid diversion of the trade into British hands as a permanent asset. The great increase in the importation to the Home Country has been of much assistance to soap-makers and other industries using the the fatty oils, and has rendered timely aid to the farmer in his endeavours to meet the home demand for more meat and milk during the coming months. Tests made at the agricultural colleges on fattening by decorticated cotton cake, by linseed cake, and by palm kernel cake, show that the last named (taking into account manurial values) yields the best monetary return. It contains a very heavy percentage of oil and can be easily stored. Altogether there is promise of very valuable results from the new enterprise, which has the advantages of employing home labour, improving agricultural returns, and extending Imperial reserves of a useful agricultural and industrial product.—UNITED EMPIRE.

RUBBER.

RELATION OF RAINFALL TO CROPS.

The Statistical Committee of the Rubber Growers' Association (Incorporated) forwards charts* and statements showing the percentages of crops harvested, and of rainfall recorded, monthly in 1913 and 1914, by a representative number of rubber estates in Ceylon and Malaya. The figures are computed on annual crops of from seventeen to twenty million pounds of rubber in the Malaya chart, and from five to seven million pounds of rubber in the Ceylon chart. The investigation was undertaken at the suggestion of Mr. H. K. RUTHERFORD, and that gentleman and other Members of Council and of the Association were instrumental in obtaining the data from which the charts and tables have been prepared.

It will be noticed from the tables, which we print as received, that there is not great variation in crop percentages between 1913 and 1914 in either country.

The charts show that the wintering period, which occurs in February and March, coincident with the lowest rainfall, has a much greater effect on the crop of rubber in Ceylon than is the case in Malaya, but the figures are no doubt affected by the practice on some estates in Ceylon of ceasing or reducing tapping operations during the wintering season. The variation in the daily distribution of rainfall in the respective countries and in the different districts must also be taken into account.

The heaviest yielding month in Ceylon produced more than four times the quantity of rubber harvested in the poorest month (13·30 per cent. in December, 2·91 per cent. in March, 1914), and the crop of the Ceylon estates for the first six months of 1914 was only 36·26 per cent. of the total. In Malaya the fluctuations between the highest and lowest yielding months are much less pronounced (9·94 per cent. in December, 6·87 per cent. in March, 1914), whilst in the first six months of 1914 the Malaya estates harvested 45·49 per cent. of the total crop.

The Statistical Committee is asking company members to ascertain from their estate managers the approximate length of time rubber requires to dry each month, and to communicate the information. It would appear that machinery and drying space required should be less in Malaya, where monthly outputs do not show any extreme fluctuation, than in Ceylon, where as much as one-seventh of the year's crop is harvested in a single month.

It is the intention of the Committee to continue these charts from year to year, in order to see if the subsequent years conform the results shown by the present charts.

* Not reproduced.

CEYLON.

	1913.		1914.	
	Crop.	Rainfall.	Crop.	Rainfall.
January ...	6·68	10·21	8·09	2·66
February ...	4·76	3·63	5·38	1·95
March ...	3·23	2·97	2·91	6·97
April ...	5·54	8·64	5·82	7·60
May ...	6·49	9·46	7·35	10·80
June ...	7·82	5·82	6·71	16·74
July ...	8·76	6·44	8·96	5·09
August ...	9·71	4·91	9·15	5·05
September ..	9·42	5·10	9·40	9·89
October ...	10·46	20·55	10·38	16·73
November ...	13·50	10·94	12·55	8·85
December ...	13·63	11·33	13·30	7·67
	100·00	100·00	100·00	100·00

MALAYA.

	1913.		1914.	
	Crop.	Rainfall.	Crop.	Rainfall.
January ...	7·97	8·60	7·94	6·47
February ...	7·29	3·52	7·58	5·20
March ...	7·61	8·09	6·87	6·41
April ...	6·95	9·44	7·19	12·44
May ...	7·76	8·73	7·95	4·85
June ...	7·78	8·00	7·96	7·91
July ...	8·69	4·25	8·61	5·34
August ...	9·02	4·45	8·39	5·33
September ...	8·70	8·73	9·07	7·28
October ...	8·93	10·95	9·21	15·62
November ...	9·27	15·36	9·29	13·38
December ...	10·03	9·88	9·94	9·77
	100·00	100·00	100·00	100·00

—INDIA RUBBER JOURNAL.

STANDARDISING RUBBER.

THE ILCKEN-DOWN PROCESS.

DEMONSTRATION IN MALACCA.

A demonstration of this latest process of preparing rubber for the market, which we described in detail recently, took place in the factory of MR. TAN CHAY YAN at Malacca on Saturday last, in the presence of several European and Chinese representatives from the neighbouring estates. The latex treated was from MR. TAN CHAY YAN's Bukit Lintang Estate, which was the first to

be planted with seedlings from the Singapore Botanic Gardens about 18 years ago. Both the patentees MESSRS. ILCKEN and DOWN were present, and whilst the former carried on the demonstration the latter explained and answered questions.

THE APPARATUS.

The apparatus consists of a circular zinc tank fitted with a cover and a stirrer. At the base of the tank an injector is fitted with 1/32 in. bore. To this injector is attached a length of rubber tubing connecting with a receptacle containing the precipitating mixture, solely composed of benzine and methylated spirit. The latex was measured and poured into the tank, and stirring was started. As soon as the latex thickened the mixture was gradually forced into the tank by a small foot pump, steady stirring being continued. The clot formed rapidly and after a short interval was removed from the tank and creped. The feel of the lump was much harder than we are accustomed to see with ordinary coagulation and it was noticed that the crepers found the coagulum very resistant.

It was announced that after testing the first shipments manufacturers have made strong enquiries and several estates have applied for licences to work under the patents. MR. TAN CHAY YAN also decided to try the process on his estate.—THE MALAYA TRIBUNE.

GINGER.

Ginger may be planted from August to November, or as late as December, putting the sets about one foot apart each way. The white varieties do better if planted twenty inches apart, and eight inches apart in the rows, the yellow requiring more space. When planting, the sets should be merely covered with soil, or better still, with old cow manure. The shoots will come above ground in twelve or fourteen days. The only cultivation needed is to keep the surface soil loose and clear, but not more than an inch of soil should be stirred. During the process the plants are all the better for a few shovels of rich, old compost added to the surface; the yield is in proportion to the richness of the soil. The roots are ripe in about seven months from the time of planting. The white sorts are the richest in flavour. The smaller, or narrow-leaved, variety is that used for the dry ginger of commerce. For this purpose the roots are allowed to lie in the ground until the leaf stalks have withered. They are then dug up and washed, the outside skin is scraped off, and the roots are dried in the sun.

PRESERVED GINGER.

To make preserves, the roots are dug as soon as they are fully grown and before the leaves begin to wither; they are then washed and scraped, cut into slices, and put into jars with salt and water for a few hours, or just sufficiently long to take away any earthy flavour. Then the slices are rinsed in clean water, and are put into a jar with a thin syrup made from white sugar. Change the syrup in three or four days, or as soon as it shows signs of fermenting. Reboil it, adding more sugar, and pour it upon the ginger again. This may have to be done three or four times, until the ginger has lost all its wild flavour, and is perfectly sweet and aromatic. It can then be covered up for future use.—QUEENSLAND AGRICULTURAL JOURNAL.

FRUIT.

MANURING BANANAS.

R. G. BARTLETT.

By experiments carried out in different places, it has been conclusively proved that potash is most essential to ensure successful results from the manuring of bananas. Owing to the war, potash cannot be obtained, as Germany was the sole source of supply. Growers are therefore in rather a quandary as to what is the best thing to do under the circumstances. Numerous inquiries on this subject have led the writer to give a short resumé of his investigations on this subject, with acknowledgments to J. C. BRUNICH and ALFRED E. STEPHENS.

The Influence of Lime.—The chief function of lime is a mechanical or physical one on the soil texture. Heavy clayey soils are rendered more friable and less tenacious, whilst, on the other hand, light, sandy soils are made more retentive by its use. It is the chemical action of lime, however, which concerns us most closely at present. Lime counteracts any acidity and destroys the ill-effects of certain soluble iron salts.

It, again, liberates valuable mineral plant foods, chiefly potash, existing in unavailable form, and helps in the decomposition of organic (vegetable, etc.) matter.

Lime favours bacterial activity by counteracting the formation of excessive and undesirable acidity. Particularly does it assist the valuable bacteria of nitrification, which change ammonia salts into nitrates, and in making the nitrogen available to plant life. It is only by the action of the myriads of bacteria, with which every fertile soil teems, that the different plant foods in organic materials are made available to the crops.

Lime, as a direct plant food, is commonly present in most comparatively virgin soils in sufficient quantities. With constant cropping, cultivation and the action of the continuous use of certain fertilisers, such as sulphate of ammonia, superphosphate, dried blood, etc., the lime becomes gradually removed, so that the soil, besides becoming possibly actually deficient in lime as a plant food, also acquires an acidity or sourness unfavourable to successful plant growth.

It therefore follows that, where orchards have been previously manured heavily with potash and dried blood, sulphate of ammonia, or superphosphate, without periodical applications of lime, great results may be expected from applying heavy dressings of lime, followed two months later with applications of dried blood and superphosphate.

In order to demonstrate this, the bananas on the school plot were given a heavy dressing of lime—4 to 5 lb. per stool—at the end of July, while this month (October) 2 lb. of dried blood and 1½ lb. of superphosphate were applied to each stool.

Slaked lime (agricultural lime) is recommended in preference to limestone screenings which, though cheaper, are slower in action.

It must not be inferred that potash manures can be dispensed with altogether, but that, so long as sufficient potash is present in a soil, either naturally or as a result of previous heavy potash manuring, liming and manuring as above will help to temporarily dispense with the necessity to use further potash.

Remarkable improvement is noticed in the school vegetable plot from the use of lime this year. Hitherto only very average results have been obtained, even when manuring the vegetables with farmyard manure, with the addition of dried blood, superphosphate, and potash. So much has this been the case, that successful vegetable growing under ordinary conditions was almost despaired of. Lime has changed all that. Light dressings of lime before digging up the beds and the addition of small quantities of lime to the water-tank and the vegetables, now bear comparison with the best, even though artificial fertilisers have been dispensed with.—QUEENSLAND AGRICULTURAL JOURNAL.

DISEASE OF MANGO.

A bacterial disease of the mango is reported from South Africa, whereby a large percentage of the fruit falls to the ground whilst yet immature. Infection occurs on leaves and branches as well as fruit, and so the disease is propagated from one crop to the next. On twigs and branches discoloured spots occur which are followed by gumming and the development of deep cracks. The disease has been found to be a rod-like bacterum (*B. mangiferæ*). Infection is carried by wind and distributed in the tree itself by rain water.

TOMATO GROWING.

Sow the seed in rows 3 or 4 inches apart, ¼ to ½ inch apart in the row, and cover about ½ inch deep. After the seeds have been covered, water the surface of the soil with a sprinkling can, being careful to distribute the water uniformly over the bed.

Water the bed in the morning and on bright days. The seed bed should never be allowed to dry out, but great care must be exercised in watering, as excessive moisture is conducive to the development of damping-off.

For a very early crop, transplant the young plants as soon as they develop their first true leaves. The plants may be transplanted to stand 2 inches apart each way in the bed, and when the plants reach a height of 3 or 4 inches and begin to crowd each other in the bed they should be taken up and transplanted again. Old tomato cans which have had the tops and bottoms melted off are very satisfactory for this purpose where the work is done on a small scale. On a large scale the grower will very seldom go to the trouble of transplanting the plants more than once, and quite often they are taken direct from the seed bed to the field. Where earliness is an

important factor, the plants should be transplanted at least once, and on a small scale it will pay to transplant twice.

Before the plants are set out they should be hardened off, and this must be done gradually in order to prevent any serious check to growth.

Seeds may be sown in beds or boxes. The boxes should be filled with a rich, mellow soil and the seed sown the same as in a hotbed. Unless the plants develop in the light, they will be weak and spindling. Close attention must be given to watering. On warm days the boxes containing the plants may be placed outside in the sun.

Select, if possible, a well-drained sandy or sandy loam soil, preferably one nearly level. Avoid land that has been in tomatoes the year before, especially if there has been any disease on the plants, as many of the diseases live over winter in the soil. Soil on which cotton or any other crop has been injured by nematodes, or gallworms, causing root-knot, should also be avoided.

Plow the land in the fall if there is no danger of washing. Replow in the spring and thoroughly pulverize the soil by disking, harrowing, and dragging, or rolling. The depth to plow depends on the condition of the soil and the previous treatment it has received. A deep soil is desirable for tomatoes, but it would not be advisable to plow 8 inches deep if the previous plowing had been only 4 inches deep. It is best to deepen the soil gradually, plowing 5 or 6 inches deep the first year and a little deeper each year until the desired depth is reached.

Barnyard or stable manure is valuable for tomatoes on most soils, as it adds both fertilizer and humus. Coarse manure may be applied broadcast at the rate of 20 tons or more per acre and plowed under. This should be applied in the fall and plowed under or applied to the crop preceding the tomatoes. If well-rotted manure is used, apply it broadcast after the land is plowed. Thoroughly harrow it in and mix it with the soil before setting out the plants.

In addition to the manure, most soils need some commercial fertilizers, especially those furnishing phosphorus and potash. It is a good plan to apply a fertilizer that contains some nitrogen in a readily available form. For an average soil in the South the following fertilizers will give good results when used with manure : 100 to 150 pounds of nitrate of soda, 500 to 1,000 pounds of 16 per cent. acid phosphate, and 150 to 300 pounds of muriate of potash to the acre. On poor land use the larger quantities, Where no manure is used apply 400 to 800 pounds of cottonseed meal in addition to the other fertilizers mentioned. If a ready-mixed fertilizer is used, one giving 2 per cent. of nitrogen, 8 per cent. of phosphoric acid, and 6 per cent. of muriate or sulphate of potash will give good results. Commercial fertilizer will not give good results unless the soil is well supplied with humus. Where manure can not be secured, some crop such as cowpeas, soy beans, or some other legume should be turned under to supply humus and part of the nitrogen.

When large quantities of fertilizer are used, apply it broadcast and harrow it in. Fertilizer applied at the rate of 500 to 1,000 pounds per acre should be distributed in a strip along the row or in a furrow and thoroughly mixed with the soil to prevent the burning of the plants.

Have the soil well prepared before starting to plant. Mark off the rows about 4 feet apart. The distance to set the plants in the row depends upon the methods of growing. If the plants are to be pruned to one or two stems and tied to stakes or trellises, 2 to 3 feet apart is sufficient space to give between the plants in the row. Where the plants are not pruned and staked, set 3 to 4 feet apart in the row. In a small garden where the plants are pruned and staked and all cultivation is done by hand, the rows can be $2\frac{1}{2}$ feet apart with the plants 2 feet apart in the row.

Before taking up the plants, thoroughly soak the bed in order to have as much soil as possible adhere to the roots of the plants. Take up the plants with a trowel or spade and pack them in boxes to carry to the field. When the plants are grown in pots, all of the soil should remain around the roots. Set the plants in the furrow and pack the soil around them with the hand. Do not open the furrows very far ahead of the planting, as the soil dries out when exposed to the air. When the soil is very dry at planting time, use enough water to moisten the soil around the plant, and after the water has soaked into the soil pull some loose dry earth over the moistened area.

Give the tomatoes frequent shallow cultivation in order to keep down the weeds and maintain a loose soil mulch over the surface to prevent evaporation. Cultivate after each rain, as soon as the ground is in condition to work. Do not allow a crust to form. As a general rule, a small-tooth cultivator should be used rather than a shovel plow, sweep, or turnplow. Keep the soil loose between the plants by the use of a hand hoe, and keep the weeds down at all times, as they rob the soil of moisture and plant food that should go to the tomatoes.

It is customary in the South to prune the tomato plants and tie them to stakes. Soon after the plants are set out a stake made from a sapling, a mill edging, or a 1 by 1 inch strip 4 or 5 feet long is driven down near each plant and the stem is tied to it. The plants are pruned to one or two main stems, and all the shoots that grow in the axils of the leaves are pinched out. These shoots should not be allowed to get large, as they take the nourishment away from the main stems. Use a soft twine for tying the plants to the stakes and have it loose about the stem, so as not to interfere with the development of the plant. A good plan is to loop the string around the stake and tie it around the plant under a leaf stem. Go over the field once every week or 10 days to pinch out the shoots and keep the plants tied up to the stakes.

The staking and pruning will expose the fruit to the air and sunlight and cause it to ripen more evenly than if left lying on the ground. The fruit will also be earlier and more uniform in size, but the crop will probably not be any larger. The tomatoes can be cultivated and sprayed to better advantage when trained to stakes or trellises of any kind.

Tomatoes should not be grown on the same land year after year, because some diseases live over winter in the soil and injure the new crop. The soil can be kept in better condition by following a system of rotation, especially when some leguminous crop is grown. Potatoes, eggplants, and peppers should not follow tomatoes, as some of the same diseases and insects affect all of these plants. It is better to follow tomatoes with such crops as peas,

beans, cabbage, or a general farm crop. It would be a good plan to plant a cover crop on the land after the tomatoes are harvested. Where the season is long enough for getting a good growth, cowpeas, crimson clover, or some other leguminous crop should be grown. If the tomatoes are not harvested until late summer or fall, rye or oats and winter vetch could be sown for a cover crop and turned under. The year preceding the growing of tomatoes it would be a good plan to grow corn with cowpeas, soy beans, velvet beans, or peanuts between the rows. Turn under the vines and corn stubble in the fall or winter to furnish humus. Whatever system is followed, a leguminous crop should be turned under once in two years. This can be done the same season a money crop is produced.

There are many diseases affecting the tomato in the South, and in order to grow the crop successfully it is necessary to practice certain preventive measures as follows :

(1) Where diseases are causing considerable damage, tomatoes should not be planted on the same land more than once in three years.

(2) Practice a good system of rotation, but avoid growing potatoes, eggplants, and peppers in the rotation with tomatoes, as some of the same diseases affect all of these plants. Do not plant tomatoes on land that has grown any plant affected with rootknot.

(3) Do not use soil for the seed bed that has grown diseased plants. It is best to change the soil in the seed bed each year.

(4) As a preventive measure spray with Bordeaux mixture every week or 10 days, giving the first spraying before removing the plants from the bed. Tying the plants to stakes is an aid in thorough spraying and allows a free circulation of air.

(5) Practice a system of cultivation which keeps the plants in a thrifty growing condition at all times. A weak or stunted plant will ordinarily be injured by disease quicker than a strong-growing plant.

(6) Where the blossom end-rot is serious, practice irrigation, if possible, as lack of moisture is probably one of the main causes of this trouble. Spraying is of no value to keep this disease in check.

(7) Avoid the use of fresh manure the same season the tomatoes are grown.

(8) Pull up and burn all diseased plants when disease first appears.

To secure the best results in spraying, the spray material should be applied before the disease appears, as all treatments are preventive rather than curative. Begin the spraying while the plants are still in the seed bed, and keep the plants well covered with the spray solution at all times. Use a nozzle which gives a fine mist ; thoroughly cover but do not drench the plants.

Bordeaux mixture is the best preparation to use as a spray. The formula for making it is as follows :

Copper sulphate (bluestone) ...	4 pounds
Quicklime	4 pounds
Water	50 gallons

Dissolve the copper sulphate by suspending it in a bag near the top of the water in a wooden or stone vessel. Slake the lime in another vessel, dilute each solution separately up to 25 gallons, and pour together the dilute solutions. Stir the mixture thoroughly while the two ingredients are being united, and keep it well stirred while it is being applied. After the solutions are poured together they should be used immediately.

When Bordeaux mixture is used in large quantities, it is advisable to make stock solutions. This can be done by dissolving 50 pounds of copper sulphate in 50 gallons of water, slaking 50 pounds of lime, and diluting to 50 gallons. The stock solutions must be thoroughly stirred before they are used, in order that they may be of uniform strength throughout. To make up 50 gallons of Bordeaux mixture, take 4 gallons of the copper-sulphate solution and dilute to 25 gallons and 4 gallons of the lime water diluted to 25 gallons. Then pour the two solutions together into the spray tank, as already described.—U.S.A. FARMERS' BULLETIN, 642.

EFFECTS OF WIND ON LIME TREES.

The question of the influence of wind on lime trees has been recently brought under renewed consideration by a report of the Mycologist of the Imperial Department on conditions in Montserrat. From various considerations it is suggested that an increase of vigour would be obtained as a result of closer protection, which would enable the trees to resist the attacks of root grubs, scale insects, and certain weekly-parasitic root and stem fungi which at present give trouble in that island.

As a contribution to the discussion the Commissioner of Agriculture invited an expression of views on this subject from the principal agricultural officers in Dominica and St. Lucia, these being the islands in which lime cultivation has received most attention. The communications received are given below, and it will be seen that the results of experience in the two islands are in very close accord.

MR. JOSEPH JONES, Curator of the Dominica Botanic Gardens, writes:—"Generally it may be stated that 95 per cent. of the lime cultivation in Dominica lies snugly in sheltered valleys or under the protection of windbreaks. Mistakes may be made by planters, particularly young men from England who are engaged in learning planting, but when it is perceived that the fields are subject to persistent winds, and that windbelts cannot be established, or if established would not adequately protect the lime trees, as in the case of rising ground, then attempts to establish lime fields under such conditions are abandoned.

"I have in my mind's eye a picture of a large field of limes on a windward estate. The lower part of the field is protected by windbelts, the results in crop being good. The upper part of the field is exposed to the trade wind. Here the trees are stunted, with the usual dead tops, and the crop obtained does not pay the cost of weeding the field.

"Lime trees can and do stand a considerable amount of wind provided there are periods of comparative calm between when young growth can be made and hardened. It is the persistent deadly trade wind which blows for months on end that is to be feared. This stunts the plants from the start and portions of the small branches dry up, but the trees do not die. They struggle on, and with alleviating conditions, such as windbreaks, may ultimately succeed, but do not become first rate cultivations. I do not know of any lime trees, young or old, being actually killed by the effect of the wind. Possibly this is due in a measure to guava and other bush springing up quickly in abandoned fields and affording some protection.

"There have been cases in which young planters, ignorant of the effect of the wind on lime cultivation, have considered windbreaks unnecessary and caused them to be cut down. In each case the results have been disastrous. The only means of again improving the cultivation and making it profitable is by the long process of establishing new windbelts.

"In Dominica experienced planters and all the peasants know that the chief enemy to cultivation is persistent wind. This knowledge has become ingrained owing to long association with cacao cultivation. The importance of thoroughly understanding the effect of wind on cultivation may be illustrated as follows :—Suppose that two island communities with similar climatic conditions and topographical features were about to embark on lime cultivation. Suppose that in one island sugar had been the staple crop, in the other, cacao. There is no doubt in my mind that the cacao planters would build up a successful lime industry while the cane planters were blundering along, because one community (cacao growers) had been compelled to study the effect of the wind on cultivation and would act on the knowledge gained, and the other (cane growers) had no particular need to trouble about it, and consequently would give little or no thought in the initial stage to this important factor in lime growing.

"Although lime trees can stand much more wind than cacao, there is no doubt that this cultivation must receive a considerable measure of protection if good results are to be obtained."

MR. ARCHIBALD BROOKS, Agricultural Superintendent, St. Lucia, writes :—"If the plants are set out in a field exposed to strong winds the plants do not make good growth in the early stages. They form smaller leaves, often only half the size of those previously formed in the nursery beds. The shoots are stunted and often possess more spines than leaves. The plant seldom if ever dies from the wind, but lingers until killed by pests or disease.

"Sometimes young limes are planted in such situations that they are only exposed to strong winds at certain seasons of the year (about March and April) ; in such instances the plants make good growth during the rainy season, and are partly stripped of their leaves during the months mentioned. This sometimes accounts for lime plants being found in a lingering state when eight or ten years old.

"Again limes are often planted where they have sufficient protection during the first few years, but later their tops extend beyond this protection and at once become stunted.

"I doubt very much if there is any authentic case on record where any lime tree has been directly killed by wind.

"Wind is undoubtedly one of the greatest evils with which we have to deal in lime cultivation, and I believe it will be found that the condition of much of the diseased and unprofitable lime cultivation now existing is indirectly caused by insufficient protection.

"Limes should be protected from wind in exactly the same way as cacao, not with the object of maintaining a heavy humid atmosphere such as cacao requires, but one sufficiently humid to prevent the young shoots and leaves from becoming wind-hardened.

"Whether the lime tree is originally planted in an exposed position or whether it extends until it becomes exposed does not affect the case. From the time of its exposure to wind its progress is stopped and it becomes unprofitable and unhealthy until the conditions are improved."

The actual physiological effects which wind or, it would be better to say, exposure produces in the plant organs have as yet received little attention. Reduction in size and increase in thickness of the leaves is well known to occur in many plants as a reaction to conditions which tend to induce increased transpiration, or where the supply of water is for any reason inadequate. The effect of this reduction on the economy of the plant has not, so far as the writer is aware, been closely investigated, but stands in familiar association with reduced or even stunted growth. No doubt it is some degree of this condition which MR. BROOKS refers to as "wind-hardened." It is evident that for economic efficiency the lime tree requires to be grown under circumstances in which it is free to develop the softer and more generous type of foliage. The factor controlling this ability is atmospheric humidity, which in exposed situations is liable to be dispersed by the freely moving air. Hence the need for wind-breaks.

The writer has little doubt that another factor is of considerable importance, not so much in the typical districts of Dominica and St. Lucia perhaps, but on lands such as those of Montserrat where the country is more open and the dry season more pronounced, namely, the loss of moisture from the upper layers of the soil. The lime is normally a surface feeding tree. When grown in districts liable to seasonal drought the root system develops at a somewhat deeper level, but indications have been found that the fibrous roots developed in the wet season are killed out in the dry months, sometimes to a serious extent. One of the results of exposure is a marked increase in this effect. It is permissible to inquire whether in some cases the highly beneficial results obtained from heavy applications of vegetable mulch have not been largely due to its action as a soil covering rather than to the manurial effects more commonly attributed to it in this connection. The quickness of the results obtained in some observed cases seems to support this view. On the other hand, the presence of large quantities of growing herbaceous vegetation about the tree increases the rate of loss, and it would seem desirable to reduce its transpiring surface as much as possible by cutting it just before the advent of the dry season.—W. N. in AGRICULTURAL NEWS.

MR. DIVERS, V.M.H., Belvui Castle Gardens, Grantham, writing to the GARDENERS' CHRONICLE about a remarkable crop of potatoes raised on the gardens, asks if it constitutes a record. The crop weighed 43 tons per acre in addition to small tubers which, however, were not numerous. The crop was not given any special attention.

FIBRES.

RAMIE CULTURE AND DECORTICATION.

MR. HERBERT CARTER.

Ramie should be capable of yielding much larger crops of useful fibre per acre, per annum, than those now obtained in India. The best yield to be secured to-day is estimated as being one-third of a ton of useful fibre per acre, per annum; yet in Haute-Vienne, in France, in a soil and climate apparently no better suited for the growth of the plant than that of India, and one in which the plant has winter and frost to contend against though drought is uncommon, a yield is got of two tons of useful fibre per acre annually in cultivation. The land is manured every three years, and each spring it is weeded, while if drought occurs it is watered. The plants upon it have been set 1ft. × 1ft. apart, always, which is very much closer than the distances observed in planting in India to-day. That Ramie is not much more extensively grown in India is due to the fact that planters consider the prices offered by Ramie spinners for the fibre at present are not in accordance with its merits as a textile. Spinners do not show the grower a sufficiently encouraging profit upon his labour. Other field crops pay planters better, but this condition of affairs would be soon altered if planters by adopting a better system of cultivation were able to get larger fibre crops from off their land.

As drought does occur in India, irrigating trenches have to be ploughed between the lines in which the plants are set, and the horse, or more frequently, the ox plough has to be put through these trenches after every cutting of matured stems in order to clear them of earth which has fallen in at various places, and weeds which have sprung up, which if allowed to remain would destroy their irrigating power. The passage of the plough takes up a good deal of land space, and the best authorities on Ramie culture are agreed in saying that if the maximum yields of useful fibre are to be got not a single foot of good productive land on a growing estate should be allowed to go to waste. There are many advantages to be gained by planting Ramie close instead of wide. For example, we have it on the authority of DR. ROYLE, formerly Advisor on Economic Products to the Government of India, as stated in his standard work "THE FIBROUS PLANTS OF INDIA," that where such plants as Flax, Hemp, and Ramie are planted close, instead of wide apart, as the sun's rays and atmosphere have less free entrance amongst them the sap in them does not become so dried up, and so not only is a longer, stronger, and softer fibre serviceable for textile manufacturing obtained from them than when they are planted at wide distances apart but, in addition, much larger yearly crops of useful fibre. Close planting has, further, been amply proved by MONS. FAURE, who grows Ramie at Limoges, Haute-Vienne, to induce the rigorous growth of tall, straight stems. These are the kind of stems which decorticate the easiest, and with the least fibre waste in decorticating machines to get rid of the stem's centre woody core, and extract the bast which lies between these two and which contains the useful fibres. Ramie, therefore,

in order to succeed as a fibre crop should be planted as close as possible. One circumstance which should enable this to be done, in the future, is the fact that MESSRS. RANSOM, SIMS, and JEFFERIES, the well-known agricultural implement makers of Ipswich and Bury St. Edmunds, in the South of England, make a small, narrow plough, weighing only 25 pounds in weight, which can be dragged along the fields by two people one in front of the other by pulling at a rope. This plough they have already exported to India. The space which it occupies, it need hardly be said, is much less than that which a broad ox or horse plough takes up.

It might be found quite wide enough apart in Indian and general Ramie cultivation if the plants were set at one foot or fifteen inches distance apart from each other in the rows, and the lines of plants were drawn two feet distance apart from each other. The horse or ox-plough could be used to plough the fields in the first instance, before the planting is undertaken, and then such a narrow hand drawn plough as that MESSRS. RANSOM, SIMS and JEFFERIES make be used, afterwards, to clear the irrigating trenches. Land waste would be totally avoided, if this were done. In some places to-day Ramie is grown as wide apart as four feet by four feet, always, in India, and two feet between each plant set in the lines, and three feet space between each line of plant seems to be the general distance observed. Clearly too much good land space is left around each individual plant in these cases, and the theory that a less number of plants on a given surface space will, individually, yield a larger number of tall stems than a large number of plants set upon the same surface space seems to be wrong; in fact, experience in culture in Haute-Vienne proves it to be absolutely wrong. MONS. FAURE sets 40,000 plants to the acre on his land at Haute-Vienne. Ramie in its growth calls for one good deep hoeing once a year, besides which there should be two light hoeings to keep down all weeds. One good manuring every second or third year answers best. These remarks apply to its culture in the East.

The next most important thing for the cultivator to watch is to see that he gives the plant no more than a sufficiency of moisture in its growth. If the plant is allowed to get too much moisture, while it will shoot up quickly, its fibre yield will be small and poor in quality; if it receives too little moisture, it will languish and its growth will be stunted; while if both these conditions are allowed to prevail in any one season, the plant will yield irregular fibre which will make a great deal of waste in preparing and spinning in the mills, and only small crops. No doubt the officials of the Agricultural Research Institute, Pusa, or of the Economic Products Department, Calcutta, will, if asked by cultivators to do so, be able to tell them pretty accurately what is the correct amount of moisture to supply to the plants in the various districts in India, and nothing promotes the growth of Ramie better than to strip the leaves from the stems at the harvest and hoe them into the ground, collect the centre woody cores of the stems in heaps in the fields, burn them, and hoe their ashes into the soil; and generally return to the soil all the refuse of decortication; green woody matter, pith, oxidised juices, etc., all should be spread over the fields, and returned to the land.

To want in the moisture supply may be attributed the faults of brittleness, and lack of strength when they show themselves in the fibre, and these, it must be remembered, are seized upon by many as an excuse to belittle its

natural merits and offer only poor prices to growers for it. The less frequently these faults manifest themselves the better for the industry. Once the culture of Ramie is thoroughly understood, there should be no industry in India more extensive or profitable. Great care in the above respects is, or rather has been, up to lately, exercised by all German overseers of lands in China, on which Ramie, or China grass was cultivated for use in Germany and Austria.

As for the decortication of the fibre or the extraction of the useful bast, one method other than machine preparation is worthy of official notice and consideration in the East, although it must be clearly understood that its product is not liked by Ramie spinners nearly so well as China grass, or hand cleaned Ramie or Ramie cleaned like China grass by any machine which does not damage the natural good qualities of the fibre in any way. This is the process of Steam Decortication. In this process the green stems when cut are placed in boxes, eight feet long, two feet wide, and three feet deep, made of good wood, having a lid on hinges at the top, and each being provided with a perforated false bottom under which runs a coil of metal piping for steaming purposes, each box having an aperture at one of its bottom corners for the escape of the condensed steam, and the lids being closed, steam which is superheated is injected into the boxes at 302° F. for fifteen minutes for fresh green stems, 352° F. for dried stems from a small portable boiler, having a fire-box beneath it filled with water nearly to its top, which may be moved on its wheels from one part of the plantation to the other. At the expiration of this time the box is opened and the stems taken out ; it will be found that the connection between the outer cuticle or skin of the stem, the inner useful fibrous bast, and the centre woody core of the stem having been rendered very loose, the skin and bast can be easily and quickly stripped from the centre woody core of the stem and separated from one another, the centre woody cores being cast on the fields. Juveniles and old people being readily trained to do this work, they can produce a fair quantity of fibrous tissues daily. These tissues should be rinsed in clean water. While the contents of one box are being steamed, another box may be filled with stems, two boxes being used with each boiler, and as many boilers and boxes may be used on a plantation at the harvest as its owners think fit. The steam does not seem to harm the good qualities of the fibre in any way. The tissues are a good article, and though not liked as well as China grass, they are a better article in every way than Black Ramie Ribbons, as, having no cuticle upon them they are easier to degum, and the good strength of the fibre so runs less risk of being damaged. With practice in this method of separating the fibre, juveniles and old people should become more and more expert. The steam generated in the boiler should be conveyed to the metal piping which runs underneath the wooden chests or boxes by means of a coil of piping. When the separation of the tissues from the cuticle and centre woody cores of the stems has been effected the tissues should be rinsed in clean water and dried carefully. The planter should bear in mind that nothing is more conducive to brittle Ramie and Ramie of weak strength generally than to bale it in a damp condition, for when this is done fermentation sets up in the fibre on its way to the mills and rots it.

The variety *Boehmeria nivea*, the underneath sides of the leaves of which are silvery white in colour, which is the variety indigenous to India, is

the best variety to cultivate; it possesses undoubtedly superior spinning qualities to the fibre of *B. tenacissima*, the upper and lower portions of the leaves of which are quite green in colour, because while its textile strength is not quite as good as that of the fibre of *B. tenacissima*, spinners find they can spin it into much finer counts of yarn than they can the fibre of the last named variety. This circumstance would seem clearly to prove that its all round strength makes it much the better of the two varieties.

Another reason why Ramie should be sown close is because this checks side branching of the plant which is fatal to uniformity of fibre, and the more uniform a fibre is the higher is its market value. Every break in the parent stem tends to destroy the continuity of the fibre; and it is essential that this should be preserved, as far as possible.

Endeavours to ret Ramie have, up to the present, ended in disappointment, as it is found that the fibre rots quicker than the cuticle. This is to be explained by the quantity of gummy and green matter it contains; in fact, the fermentation proceeds too rapidly. Antiseptics, such as permanganate of potash and boracic acid have been added to the ret vat to retard the fermentation, but even this has failed to secure a result which is satisfactory; indeed, if a strong fibre is to be got the less Ramie is touched by chemicals in its preparation for the market, seeing it has later to be chemically degummed, the better; and there is no doubt machine decortication is far better than the employment of drugs for this purpose, provided the machine does not damage fibre in any way.

With respect to the Bacterial Degumming of Ramie, which method has lately been invented, and patented by an Italian gentleman and is said already to have shown good results in tests in Italy, chemical aid is only very slightly utilised. The inventor is very confident of its efficacy, particularly in its not injuring the fibre's good strength, elasticity, etc., in any way. PROFESSOR DR. GIACOMO ROSSI, the inventor, is teacher of Bacteriology at the Royal School of Agriculture, at Portici, Italy. The writer hopes to give some full and accurate details of this new method of degumming Ramie, which cannot possibly fail to be of great value to India, in a later article. There are, however, several chemical degumming processes in existence to-day, and in commercial operation on a large scale, which do no harm to the natural good qualities, strength, etc., of Ramie, as, for example, the process used by Le Sociète de la Ramie Francaise, (MESSRS. P. A. FAVIERO CIE.), Extraignes, Vaucluse, France.—THE MYSORE ECONOMIC JOURNAL.

THE CULTIVATION OF SISAL HEMP.

The Sisal plant requires a tropical climate with moderate atmospheric humidity. It is very hardy, but is liable to be injured by excessive rain.

It is usually stated that the plant flourishes on rough, dry, stony or rocky soils which are unsuitable for other crops, but there is little doubt that good soils are not unfavourable. On poor soils, the plants are of somewhat inferior appearance, but yield leaves containing a large proportion of fibre, whilst on rich soils longer leaves are produced which furnish comparatively less fibre.

It is probable, however, that in the latter case the greater length of the leaf more than compensates for the lower percentage of fibre. In general, it may be stated that the most suitable soil is a dry, permeable, sandy loam, containing a certain amount of lime. Good drainage is of great importance, as the roots of the plants are sensitive to moisture and are liable to be seriously injured by standing water.

PREPARATION OF THE LAND.

The land selected for a plantation should be fairly hilly in order to allow of easy drainage. Most writers agree that it is not necessary to break up the soil to any great extent; but the land must be cleared of trees and scrub, and stumps must be uprooted in order to render the surface even. On the other hand, it is stated that in German East Africa the best results are obtained on land which has been thoroughly cleaned and well hoed. In any case, it is essential that the undergrowth should be removed, as, if the Sisal plants are shaded, the fibre becomes weak and inferior. The land subsequently requires to be lightly hoed four or five times a year in order to keep it free from weeds.

PLANTING.

The Sisal plant comparatively rarely sets seed, and its propagation is therefore effected by means either of bulbils which are formed in the manner already described or of suckers which arise from the rhizome. The bulbils are usually grown in nursery beds until about 8 to 12 inches high, and are then planted out. Suckers can be planted immediately after their removal from the parent plant. Planting is generally carried out during the rainy season, all fibrous roots and lower leaves having been first removed to facilitate new growth. The plants should be set in rows about 8 feet apart. The distance between consecutive plants in the row varies a good deal in practice, but probably 6 feet is generally the most satisfactory, this arrangement admitting about 900 plants per acre.

HARVESTING AND YIELD.

The period which must elapse before harvesting can be begun varies in different countries; but, in general, after about from three to five years healthy plants will yield leaves ready for cutting. The cutting is effected by means of a special form of blade or sickle with a curved end. Each leaf is cut off close to the trunk, care being taken not to injure the younger leaves on the plant. The number of leaves which can be cut per annum varies greatly. It is estimated that in Mexico each plant yields about twenty-five leaves a year, whilst in East Africa double that number are obtained. The average weight of the leaves in the latter country is about 2 lb., and the yield of dry fibre is approximately 3 per cent. Hence the yield of fibre per acre containing 900 mature plants should amount to about 2,700 lb., and a yield of at least a ton per acre may therefore be anticipated.

As the result of actual trials carried out at Punda Milia, it was found that 912 leaves, weighing 2,263 lb., or an average of 2·48 lb. per leaf, yielded 52½ lb. (2·32 per cent.) of dry, brushed fibre, equivalent to about 1 lb. of fibre from 17 leaves. The plants from which these leaves were cut out were spaced 8 ft. × 8 ft., this arrangement giving 681 plants per acre. Taking 160 as the average number of leaves produced per plant during its life, the total

yield per acre, when calculated by means of the above figures, is 6,240 lb., or a little less than 3 tons. As the plant lives at Punda Milia about three years after the first leaves are ready for cutting, these observations are in agreement with the estimated yield of 1 ton per acre per annum given in the preceding paragraph.

DURATION OF LIFE OF THE PLANT.

As has been already stated, the duration of life is determined by the production of the pole or inflorescence. In Mexico the plants are said to live for fifteen, or sometimes even twenty-five, years before poling, whilst in more tropical countries they live a much shorter period, the average length of life in East Africa being only about six years. In general, the duration of the plant appears to be largely dependent on conditions of soil and climate. It has been asserted that the life may be prolonged by cutting out the pole as soon as it appears above the leaves, the plant being thus rendered available for fibre for nearly a year longer than it would be otherwise; but experiments which have been conducted in German East Africa do not support this view. The early poling of Sisal plants in East Africa has been much discussed, and has been regarded by some planters as a great disadvantage. It appears, however, that the comparatively short life is due to the fact that there are two growing seasons in that country, and growth is checked twice a year, whereas in less tropical countries there is only one growing season per annum. Thus it is evident that the plant in East Africa lives through approximately the same number of growing seasons as it does in other countries, but only about half as many years. Moreover, the number of leaves produced per plant (on the average about 200) is roughly the same in each case, and hence the comparatively brief duration of life is rather an advantage than otherwise, as the total crop of the plant is produced in a relatively shorter time.

Since the plants in a Sisal plantation do not all pole at the same time, the work can be carried on continuously by the intercalary method sometimes adopted in German East Africa. As the plant lives for only about six years, cutting can only be carried on for two or three years before it dies. New plants are therefore continually inserted between the old ones, so that when one plant dies another is ready for cutting, and the work of the plantation can proceed without interruption. Some planters, however, do not approve of this method, but prefer to let all the plants in a plantation pole and die; and then allow the land to lie fallow for a year or more before replanting.

EXTRACTION AND PREPARATION OF THE FIBRE.

The fibre is extracted from the leaves by a process of crushing and scraping or "scutching." The leaves should be treated as soon as possible after they have been cut, as otherwise the juice becomes dry and gummy, thus rendering extraction more difficult. They should be graded according to length before being scutched, and the fibre of the different lengths should be kept separate. The strands of fibre must be kept as parallel as possible and not be allowed to become tangled. It must be borne in mind that good white fibre of uniform length and carefully cleaned and baled commands a much higher price than mixed fibre, ill-cleaned and badly baled.

Modern machinery for Sisal hemp extraction is based on the principle of the old "raspador" which was the earliest form of machine employed in Mexico. This machine consists of a wheel, like a 4-ft. pulley, with a 6-in. face, and with pieces of brass running across the face at intervals of about 12 in. The wheel runs in a heavy wooden case and makes about 110 revolutions per minute. The leaf is inserted through a small hole in the case, and held firmly at one end by a strong clamp, whilst the rest of the leaf is allowed to whip downwards as the wheel rotates. A heavy concave wooden block, like the brake of a car-wheel, is brought by means of a lever on to the leaf and presses it against the revolving wheel. The leaf is thus crushed and the pulp and epidermal tissue are scraped away by the brass strips and thrown into a pit under the wheel. The fibre is then withdrawn and the leaf reversed, in order that the other end may be cleaned in the same manner.

The machines which are chiefly used in East Africa are the "New Corona," the "Mola," and the "Finigan-Zabriskie."

The "New Corona" machine, manufactured in Germany, is said to be capable of extracting about 2 tons of dry fibre per day, requires 30 h.p. to work it to its fullest capacity, and demands the services of four workmen. It consists essentially of two scutching drums armed with scrapers which work against concentric, brass-lined, cast-iron saddle pieces. The leaves are automatically pulled through between the drum and the saddle piece, one half of the leaf being extracted by each drum. The pulpy matter is thus scraped away from the fibre, leaving the latter in a condition in which, after washing and drying, it is ready for export.

The "Mola" machine, manufactured in Merida, Mexico, needs about 48 h.p. to drive it. It works more rapidly than the "New Corona," and can extract about 3 tons of fibre per day. The extreme velocity necessary to effect this, however, causes a comparatively large amount of waste, but this loss is usually regarded as compensated by the greater output. The bundles of leaves as brought in from the plantation are placed by one or two workmen on a travelling lattice which carries them up to a table in front of the machine. Four men are then required to open the bundles and lay the leaves on the conveyor, which introduces them to two raspadors, arranged at right angles to one another, where they are cleaned, one-half the leaf being stripped at a time. The fibre on leaving the machine slides down on a wooden frame and is then washed and dried.

The "Finigan-Zabriskie," an American machine, is capable of extracting about 1 ton of fibre per day of 9 hours. It requires the services of three attendants, two to feed the leaves into the machine, and one to withdraw the fibre.

Several British firms are now manufacturing machinery for the extraction of Sisal hemp. Three machines are made by MESSRS. ROBEY & CO. LTD., London. These are (1) the "Duodecor," for the decortication of leaves not over 4 feet long, which has two drums each 4 feet in diameter, is capable of dealing with 10,000 leaves per hour, and requires a power of 50 i.h.p.; (2) the "Sixdecor," for decorticating leaves more than 4 feet long, which has two drums, one of 4 feet and the other of 5 feet diameter, a capacity of 13,000 leaves per hour, and requires 60 i.h.p. to drive it; (3) the "Twendecor" for use with extremely long leaves, which resembles the "Sixdecor" in construction, requires 80 i.h.p., and can decorticate up to 20,000 leaves per hour. One of MESSRS. ROBEY & CO.'s machines has been installed in the East Africa Protectorate on a plantation at the coast, north of Mombasa.—IMP. INST. BULLETIN.

SOILS AND MANURES.

STORAGE OF FARMYARD MANURE.

The problem of the storage and fermentation of manure has for long been a subject of discussion, pits and covered courts each having their advantages and disadvantages. A new system by DR. GIUSEPPE BECCARI, of Florence, Italy, is described in a recent publication from the Imperial Institute of Agriculture, and consists in the storing of the manure in turret-covered courts. The court is a rectangular structure of masonry, divided internally into two compartments about 7 feet high. The floor is paved and provided with drains covered with perforated bricks, through which air passes upwards into the manure, while the liquid manure drips through into a tank. In the top of each compartment there is a trap-opening through which the manure is thrown. Between the two trap-openings a turret is situated, with the object of collecting and fixing the ammonia compounds evolved from the fermenting manure, which enter by the apertures. In the turret, shelves placed above each other and fixed alternately to either side are charged with solid or liquid, alkaline or acid absorbents; these are collected from time to time through a door or other aperture in the turret, which has also openings at the top and bottom for the admission and escape of air. The manure is abundantly sprinkled every four or five days with liquid manure from the tank, and in forty-five to fifty days it is ready for use. Manure made in this way has been found to contain 0·54 to 0·89 per cent. of nitrogen, while manure made in the usual way is considered good when it contains 0·45 per cent. Besides this there is also the nitrogen fixed by the absorbents in the turret. From the hygienic point of view this system is superior to any other. It has been adopted in several parts of Tuscany, where the cost of erecting such a covered court sufficient for eight to ten head of cattle is about £26. The advantages of the system are (1) that of fermenting the manure in a closed space so that it attains immediately the high temperature of 158 to 167°F., evolving abundant ammonia and preventing the development and action of denitrifying bacteria and consequent loss of nitrogen; (2) that of collecting the volatile ammonia compounds, which are led into a special chamber (the turret), where they are transformed into stable ammonia salts or nitrates, by suitable absorbents, such as clayey earth, peat, charcoal, gypsum, acid superphosphates or an alkaline medium, and at the same time favour the development of numerous colonies of nitrifying bacteria.—GARDENERS' CHRONICLE.

LIQUID MANURE.

Stable, cow, sheep manure, and poultry droppings can be used as liquid manure.

Many people have an aversion to using these because of the unpleasant odours.

For those who prefer the artificial manures we can recommend nitrate of soda, sulphate of ammonia, sulphate of potash, and Peruvian guano. The latter manure, when good, makes a first-class liquid manure, but we prefer the first three.

The ammonia and nitrate of soda produce luxuriant growth and must be used cautiously. A tablespoonful of either to two gallons of water makes a strong manure, and seldom requires to be used stronger. It is better to make the manure half the strength for most plants, otherwise there is a danger of killing the plants. We are now referring to ordinary garden plants.

Avoid wetting the leaves with the artificial manures. Some tender annuals can't stand such treatment.

If it is necessary to use sulphate of potash with either the ammonia or nitrate of soda, the amounts used must be lessened, say, half of each. Half a tablespoonful of each to about four gallons of water is quite safe.

Don't use these stimulants oftener than once a week. Once a fortnight is much safer.

Before applying the manure, wet the soil thoroughly, then apply the liquid manure some hours afterwards.

These tonics may be used on most of our spring flowers, roses, sweet peas, pansies, petunias, and most flowering plants in the conservatories.

If you want delicate and handsome blooms, use the liquid manures very sparingly.—QUEENSLAND AGRICULTURAL JOURNAL.

FERTILIZED PEAT.

A NATIONAL COMMITTEE.

MR. W. B. BOTTOMLEY, Professor of Botany and Vegetable Biology, King's College, delivered at the Royal Botanic Society the third and concluding lecture on his experiments in the use of bacterized peat as a stimulant to the growth of vegetables, flowers, and grass.

SIR MALCOLM MORRIS, who presided, read a letter from the Duke of Teck, President of the Royal Botanic Society, saying that PROFESSOR BOTTOMLEY'S work would be of great service to the nation by increasing the amount of vegetables, wheat, etc., and suggesting that a national committee should be appointed to carry out experiments so that the discovery might be tested on a large scale.

The Chairman said that the council of the Society proposed to form the nucleus of a national committee to which gentlemen interested in farming from all parts of the country would be invited to join, so that PROFESSOR BOTTOMLEY'S experimental work might be used to the advantage of the nation. He believed that if this were done the food supply of the country would be doubled in a short time.

PROFESSOR BOTTOMLEY, in his address, showed some remarkably fine apples, onions, carrots, mangolds, and Brussels sprouts, grown in soil diluted with bacterized peat, as compared with smaller specimens of the same vegetables and fruit grown in ordinary soil; and also displayed to the same purpose a series of lantern views of experiments with the bacterized peat on plants and flowers in Kew Gardens.

He hoped the Board of Agriculture, which had sent a representative to the lecture, would be induced to take up the discovery. So far, the Board had declined to take action. When attention was recently called to the discovery in the House of Commons MR. ACLAND, speaking for the Board, said:—"So far as I am aware no result has been obtained which demonstrates its utility for agricultural purposes on a field scale and on a commercial basis." As a matter of fact, experiments had been made on a farm which showed that one ton of bacterized peat had produced 41 per cent. more potatoes, 26 per cent. more turnips, 43 per cent. more beet, 46 per cent. more onions, and 28 per cent. more carrots than 80 tons of farm-dung from the same soil.

"May I give you a little bit of secret history?" he continued. "In July of last year a German professor came into my laboratory with the copy of an address I had delivered on the subject and asked to have the process explained to him. I did so. Why not? He was a brother scientist, and it was before the war. He expressed his delight, and then asked quite harmlessly that he might see the bacteria. I opened the incubator for him. He then asked for a sample, but I said 'No,' because the work was not completed. Next day he came back and told the truth. He said he wanted it for the German Board of Agriculture, and that it would be worth my while to let him have it. They didn't get it, I may tell you that. But contrast it with what we get from our Board of Agriculture."

COMMERCIAL OFFER REJECTED.

He had received an offer from a commercial man to form a limited liability company with a capital of £100,000 to purchase his rights for 33,000 fully paid up £1 shares and pay him £1,000 a year as consultant chemist; but he refused the proposal on the ground that the public would probably be asked to pay £20 a ton for the bacterized peat, which cost him only £2. 10s. a ton to produce. MR. MOND of MESSRS. BRUNNER & MOND, having tested the experiments, was prepared to advance part of the money, or even all the money required; and a gentleman in Yorkshire was willing to provide peat lands free. Therefore, the bacteria, the money, and the peat were available, and he hoped that if the Board of Agriculture still refused to act, the national committee to be formed by the Council of the Royal Botanic Society would take steps to make the bacterized peat and distribute it to the people at cost price.

MR. WATSON, the Curator of Kew Gardens, said PROFESSOR BOTTOMLEY should not be so hard on the Board of Agriculture, for Kew Gardens, which were under the Board, had assisted him in his experiments. He confessed that he had yielded somewhat reluctantly to PROFESSOR BOTTOMLEY'S request that the bacterized peat should be tried at Kew Gardens. That, he thought, made all the more valuable his testimony to the efficacy of the material as applied to a series of plants in pots. He knew nothing as to the value of the peat in farming, but had no doubt its effect on vegetable growing in the open would be the same as its effect on plants and flowers.—THE TIMES.

HUMOGEN.

PROFESSOR BOTTOMLEY'S bacterised peat, now called Humogen, is receiving a good deal of attention in the newspapers, daily and other. In some of the notices statements have been made which are likely to raise doubt in the professional mind as to the genuineness of this preparation, whether faking practices are being resorted to, not by the Professor, but by others evidently anxious to make Humogen hum. There is no need for this. Humogen, as I know it, is an excellent fertiliser. I have seen it carefully tested on a variety of plants with convincing results. I know, too, that others, men of experience as cultivators, have also tried Humogen with results that were negative. The experiments at Kew Gardens were, with few exceptions, with plants grown in pots, and therefore under control with respect to water, light and other conditions which affect the growth and health of plants. It is probable that experiments in the open are liable to be adversely affected by, weather, etc. The soil, drainage, position, or the state of the plants themselves may possibly be unfavourable. Food, however wholesome it may be, cannot benefit either plants or animals if other equally important factors are neglected. The pressman who stated that Humogen would enable people to grow potatoes and other vegetables in ordinary living rooms all the year round had food on the brain, and any cultivator who, by applying Humogen expected to get food crops from soil altogether out of condition would be disappointed. I have not seen a single case of failure where the plants treated with Humogen have had ordinary attention. I confess to being puzzled by what Humogen does. The peat, before it is treated, even if all the acid were removed from it, would not be of any particular value as a fertiliser. The peat used by gardeners for peat-loving plants is not rich in plant food, no richer certainly, when judged by results, than good leaf-mould. An experiment in which good peat was mixed with other soil in the same proportion as that containing Humogen proves this, the peat making no difference in the growth of the plants. For this reason Humogen cannot be classed with manures, natural or artificial. All the good must come from the action of the bacteria with which the prepared peat is inoculated. They must operate on the food contained in the soil to which Humogen is added, and they evidently continue to operate for an indefinite time, for the plants nourish until their roots are pot-bound. I am inclined to believe that excess of soil moisture is most detrimental to the action of Humogen, or rather to the bacteria, not because water is destructive to them, but what we call stagnation must be. We have to bear in mind that these micro-organisms are alive, and that to enable them to do their work they must have suitable conditions. In a properly constituted soil Humogen is capable of working a change in its productivity which after a long experience with plants, soils and plant foods I am in a position to say is very extraordinary. I have never seen anything to equal it.—W. W. in GARDENERS' CHRONICLE.

BACTERISED PEAT.

This journal was, we believe, the first to call attention to the extremely interesting and promising experiments made by PROFESSOR BOTTOMLEY in the production of a novel kind of plant-food.

That plant-food known as bacterised peat is prepared by treating certain kinds of peat with certain bacteria. After this process, as a result of which the amount of soluble humates is largely increased, the bacteria are put out of action by heat, and to the treated peat is added another kind of bacterium, an azotobacter, which brings about a fixation of nitrogen. Preliminary experiments with this bacterised peat have given remarkable results. By the addition of small quantities to the soil the growth and yield of plants have been shown in many cases to be very greatly increased. In the earlier stages of his experiments PROFESSOR BOTTOMLEY attributed these effects to the large quantities of soluble nitrogen compounds contained in the bacterised peat.

The general appearance of the plants so treated suggested, however, that their luxuriant and sturdy growth was due to something more than liberal supplies of nitrogen compounds.

Now, recent discoveries of physiologists have shown that animals require not only the ordinary foods, but also minute quantities of other, till recently unknown, substances, to which the name of accessory food substances has been given. As a result of his further researches, PROFESSOR BOTTOMLEY claims that bacterised peat contains such accessory food substances. Whence it would follow that plants not only require supplies of ordinary substance-building foodstuffs—water, carbon dioxide, compounds of nitrogen, potash, phosphorus, lime, and the like—but also need for their proper development a supply of accessory food substances.

The idea is not only novel and attractive, but also in the highest degree important. Because of its novelty and attractiveness, it deserves to be received with ready sympathy by all who are concerned with the cultivation of plants. Because of its importance, it requires to be substantiated by irrefutable evidence before it is adopted.

It is clear that two issues are involved, which may for convenience be treated separately.

In the first place we may ask: Is bacterised peat a good manure?, that is, one which, the factor of price being taken into consideration, will give results better than, or at least as good as, those to be obtained by the ordinary organic and inorganic manures. Now, although it is true that, as we ourselves have seen, bacterised peat does not, indeed, produce very striking results, it is nevertheless, premature to pronounce a final judgment on this point. Experiments carried out with pot plants, by such a skilful cultivator and keen observer as MR. WATSON, the Curator of Kew Gardens, as well as those undertaken by others, are emphatically in favour of the value of PROF. BOTTOMLEY'S bacterised peat; but yet other experiments carried out on plants in open ground and conducted with no less care during the past two years have not yielded such encouraging results. We cannot at present give details of these latter experiments, because their author has not yet published them. Nor do we mention them with the object of suggesting that bacterised peat does not possess the virtues that are claimed for it. The evidence, in our opinion, so far as it goes at present, is strongly indicative that PROFESSOR BOTTOMLEY may have discovered a manure of the highest value. Yet, in the face of negative results which have been obtained, it behoves us to withhold a final judgment. Meanwhile, every encouragement should be given to PROFESSOR BOTTOMLEY to continue his experiments, and to carry out trials on an extensive scale.

The second issue involved is of even greater importance, and concerns the claim that plants, like animals, require for their proper development a supply of accessory food bodies. The argument from analogy may be urged in support of this hypothesis, and not a few facts which might seem to count against it may perhaps be met. For example, as is well known, it is possible to germinate a seed and cause it to grow into a perfect plant by supplying it only with water, air, and mineral salts. That this may be done, even with plants the seeds of which are very small, is not, perhaps, a fatal objection to the professor's theory. For it is open to him to maintain that the plants would have grown quicker and better if they had been supplied with the accessory food bodies. It is known that animals require but very small quantities of these substances, and it might be urged that the seeds of plants contain in their endosperm, or already in the embryo, the necessary minimal quantity of accessory food substances.

Suffice it to say that this issue is in like case with the practical aspect; namely, that the evidence is very suggestive that plants, like animals, require accessory food substances. At present, however, we do not think that the evidence is so overwhelmingly strong as it must be before the theory of accessory plant-food substances may be accepted as finally established.

We believe that PROFESSOR BOTTOMLEY has offered to put his discovery at the disposal of the State for the period of the war. It is a generous offer, and we think that the State should accept it, and that it should at once appoint a small commission of experts, including several practical growers, a botanist, a chemist, and a bacteriologist, to conduct a series of rigorous tests with respect to the manufacture and uses of bacterised peat. The preliminary work of such a commission need not delay the application of this new manure on a wide scale during the coming year, and it should be of the greatest use in settling authoritatively the value of what may turn out to be an epoch-making discovery.

It would be a great pity if the claims set up by PROFESSOR BOTTOMLEY, as the result of his long and patient labours, were, instead of being subject to rigid critical examination, left to take their chances among the credulous, always ready to believe in the virtues of some new thing, and the hypercritical, always prepared to show in advance that the new thing is naught. Enquiry into the kind of peat used as the raw material, the several stages of manufacture, analyses of the contents of the finished article and large-scale comparative trials of the effects of the new manure should serve in a few months to determine the true value of bacterised peat.—GARDENERS' CHRONICLE.

THE VALUE OF CHARCOAL TO SOILS.

GEO. A. RETAN.

Every farmer, gardener, and nurseryman should be familiar with the results of experiments carried on for a period of three years, which have demonstrated that charcoal can be made of great use in improving the structure and properties of the soil.

It improves the water and air content of the soil, loosens and intensifies the sub-soil, apart from the chemical materials it may carry, and from its uses

with manure. These are not theoretical but practical conclusions drawn from the use of charcoal in one of the largest nurseries in the State of Pennsylvania, under the management of the writer.

Two general classes of material are available for purposes of fertilization. In the first class are commercial fertilizers. In the second class are those indirect fertilizers which do not furnish plant food directly, but by their action upon the soil may so affect it as to make plant food available by setting it free, through the altering of the physical condition of the soil. The principal fertilizer in this class is lime. Lime is really a stimulant instead of a plant food, and its continued use may be harmful or exhausting to the soil. Air, water and heat are more necessary for plant growth than mineral food. Production depends upon the proper æration of the soil, the maintenance of a proper water content and through these two, the raising of the temperature of the soil. These conditions add plant food in that they render available the material that is stored away in soil compounds. The control of moisture in the soil lies in the physical state of the soil. If it is loose, porous, small grained, it will raise moisture freely from the sub-soil and hold it where it will be available for the plants and retard evaporation. The soil may be kept in such condition by proper tillage and by the addition of such materials as will affect a loosening and breaking up of the soil particles.

Green manure is valuable, and barnyard manure and charcoal, with constant tillage, are among the best known agents. In using barnyard manure the best part of the manure is often lost. A large part of the mineral content is washed out if the pile is exposed and the liquid portions leak out or escape in gases. Many different substances have been tried for the purpose of preventing this loss. One of the very best materials which can be used for this purpose is charcoal. This is true because of its exceptional power of absorption, it possessing the capacity of absorbing many times its own weight in moisture and also because its physical effect upon the soil and the sub-soil has been conclusively demonstrated. Charcoal is already extensively used as a deodorizer or disinfectant, and the fact should not be lost sight of that the ammonia gas, which is quite lost in the manure heap, would be absorbed by the charcoal and made available for plant use.

For many years the attempt to raise coniferous seedlings in this nursery, (Mount Alto Pennsylvania Nursery), was a comparative failure because of the hard clay soil, which greatly increased the loss from unfavourable moisture and surface conditions. Among the agents tried for the relief of this condition were green manure, fertilizers, and charcoal, and of these only the last has proved successful, as may be observed by the size and weight of seedlings developed from clay beds, fertilizer beds or charcoal beds. The seedlings are much larger and heavier and of better colour on the charcoal beds than on any other. Some fertilizer beds shew good seedling development, but the beds were not as densely covered with little trees as on the charcoal beds, notwithstanding that the charcoal beds were in the worst section of the nursery, while the fertilizer beds which show the best weights were in sections cultivated for a longer period. The charcoal seedlings averaged a weight of 250 grams for a bundle of 100 trees, as against 127 grams for a check bed in the same grade of soil. These trees were two years old. At one year the differences are not so striking but are strongly marked. One hundred seedlings from a clay bed weighed 22 grams, while the same number

from a charcoal bed weighed 40 grams. These beds contained a relatively large quantity of charcoal, such as could only be used in hot-beds, gardens, or other intensive work. But the same tendency is shown in the use of smaller quantities. Furthermore, the soil conditions are exceptionally bad in this nursery. From constant observation and experiment, the action of charcoal that makes it so valuable in the nursery seems to be entirely in the improved condition of moisture and warmth. It might be thought that charcoal would loosen the soil to the extent that it would dry easily if used in large quantities, but the opposite condition occurs. In dry periods the power of the soil to retain water is increased, and in wet seasons the soil drains quickly with a consequent prevention of fungus that always follows a wet season in a coniferous nursery. The clay beds, by reason of their caking habit in dry weather, and poor drainage in wet weather, exerted the opposite effects and the loss was much more marked. In some cases it was complete. Again, charcoal beds are much warmer, because of the darker colour imparted to the soil. This is of the greatest importance in the spring, when the ground has a tendency to be cold. Germination is almost entirely dependent on the warmth present and is consequently greatly helped by the darker colour of the soil. Since the darker coloured soil does not radiate any more rapidly at night, this heating effect is carried forward into the night and lessens the liability of damage from frost. In gardens and hot-beds, this is of considerable importance. This increased heat is of value in another direction. The æration of the soil depends upon the heating, and it will be greater in the soil which becomes warmer during the day.

Thus we find that the action of charcoal in the soil is exerted along the lines where the most can be accomplished. The physical conditions of the soil are so improved that the air, heat and moisture coming to the crop is regulated in the most advantageous manner, and mechanical analyses of the sub-soil have shown that the charcoal exerts a beneficial action at a considerable depth, 12 to 18 inches below the surface. The sub-soil beneath charcoal beds is of a better colour and better physical structure than soil from the surface of untreated beds. This means an increase in the water-holding power, and a breaking up of unavailable compounds into available plant food.

To the farmer especially, the use of charcoal extends a wide range of advantages. He can add to the value of his manure, can improve the sanitary condition of the barnyard, poultry house, hog pen, etc.; and at the same time improve the physical condition of his land. When used in larger quantities in gardens, nursery beds, and in intensive cultivation, it offers the best physical condition for the growing crop with a decrease of loss from fungal attacks. The action of the charcoal is comparatively permanent as compared with the other agents, which are used for the same purposes. Experiments carried on over three growing seasons have shown no lessening of the effects under the most unfavourable conditions. The agriculturists of the future must look forward to the conservation of the resources of the land. This is accomplished best by proper control of physical conditions with the subsequent fullest utilization of the natural forces of sunshine, air and moisture. Any man who will look forward to such a careful utilization of his land will surely increase his wealth materially.—HAWAIIAN FORESTER AND AGRICULTURIST.

ÆRATION OF THE SOIL.

A. G. DJARENKO.

Of the principal factors concerned in plant life (light, heat, air and nutritive substances), only the two last have been studied in such a manner as to allow of the devising of various technical methods for ensuring to plants the necessary amount of water and nutritive substances. As regards light, heat, and air, these are factors outside our sphere of influence and can be but little modified by cultural technique. In the case of the air, however, this assertion only holds good for the aerial parts of the plant, since for the normal development of its root system and the chemical and biological processes continually going on in the soil, oxygen is indispensable. It is thus evident that the conditions guaranteeing the presence of sufficient air for the plants can only be obtained by the help of an active exchange between the gases contained in the soil and the air.

These circumstances necessitate our studying the conditions which assure to plants the presence of sufficient oxygen in the soil, and to the technical means for preserving an active gaseous exchange in the soil. But, since research on the composition of the air in the soil has hitherto furnished data relating almost exclusively to its content of carbonic acid and of some other gases, and since, further, there is no connection between the amount of carbonic acid and that of the oxygen in the air of the soil, the method of indirectly determining the oxygen cannot be applied. Experiments have therefore been based on the direct estimation of the oxygen in a given volume of air corresponding to a determined volume of soil.

A special apparatus has been made for taking soil samples, and the whole apparatus for the study of soil aeration consists of a mercury pump, some small graduated tubes and a series of absorbents of the various gases.

In summarising the most important results of the experiments carried out by the writer, especial consideration will be given to those relating to the different types of fallow land, as the question of the most appropriate type is of paramount importance to Russia.

As a matter of fact the Agricultural Stations have been able to establish, after a considerable amount of research, that the so-called black fallow and the April fallow ensure the best crop of winter cereals. Further, the experiments made by the Agricultural Stations of South Russia have shown that there exists a definite connection between the manner of working the fallow and the humidity of the soil; while a series of recent experiments clearly show the importance of the date of beginning to work the fallow in connection with the accumulation of nutritive substances.

Equally important is the working of the fallow land in order to ensure the most efficient æration of the soil, and in connection with the related physical, chemical and biological processes.

The experiments were carried out on 4 types of fallow, viz., the so-called black fallow (the working of which begins in autumn), the April fallow and the two June fallows of which one, the "peasant" fallow, is characterised by having a soil much trodden by the cattle that the peasants usually put to graze upon it; the other is left unworked until June.

The results of the experiments are given in the adjoining table.*

In analysing this table it is seen that the black fallow soils and the April fallow soils always contain larger quantities of air and oxygen in comparison with the other types of soil studied; this was especially the case during the first experimental period which lasts from the beginning of working the soil until the time of sowing. As regards the modifications in the amount of oxygen in the soil of the different kinds of fallow, it appears that they are least in the case of the black fallows and April fallows and greatest in the June and peasant fallows.

Further, it may be stated that the æration of the soil becomes less and less in proportion as the soil becomes more compact and that every fresh working of the fallow makes the soil looser and increases æration, giving a new impetus to the gaseous exchange between the soil and the atmosphere.

In continuing the analysis, it is also noticeable that the consolidation of the soil takes place more suddenly in the best worked fallows, but nevertheless their air and oxygen content is always higher, especially in comparison with the peasant fallows. The amount of oxygen in 1 litre of soil varies in the following manner:—

Black fallow	59—81·5 c.c.
April ,, ...	63—81·4 c.c.
June ,, ...	52—65·2 c.c.
Peasant ,, ...	32—48·0 c.c.

In order to show better the difference between these various kinds of fallows, the data are given relating to the amount of oxygen found on August 1, i.e., at the time of sowing. Taking the oxygen content of 1 litre of black fallow soil as 100, that for the corresponding amount of April fallow soil is 107, in the case of the June fallow 86·5 and in that of the peasant fallow 54·2.

Thus, by working the fallow well, it is possible to ensure to the plant, towards the time of sowing, and throughout the autumn, a sufficient quantity of air. The June fallow differs from the black and April fallows during the first half of the summer; it approaches them in autumn, outstripping the peasant fallow, which is characterised by a low oxygen content during the whole of the summer.

After having established these differences in the oxygen content of different kinds of fallow, the writer, wishing to ascertain the influence of the winter season, made the necessary experiments on soil under rye, obtaining the following results (the soil samples were taken on April 24):

	C.C. in 1 litre of soil Air.	Oxygen.	Oxygen per cent. of air.
Black fallow under rye ...	238 ...	45·9 ...	19·3
April ,, ,, ...	232 ...	45·4 ...	19·6
June ,, ,, ...	224 ...	43·5 ...	19·0
Peasant ,, ,, ...	118 ...	24·0 ...	20·3

As is seen, the oxygen content drops to the level characterising the fallow soils on which the work has not yet been begun. The supplies of oxygen obtained by working the fallow can thus only be used by the plant during the

* Not reproduced.

autumn, since towards spring they become very small. Further, the differences observed at first between the 3 types of fallow disappeared almost entirely towards the spring, the peasant fallow alone, as before, having the lowest oxygen content.

The above-mentioned results of the study of the æration of fallow soils do not yet afford sufficient data to solve the problem of æration considered as a factor of the greater productivity of black fallow and April fallow soils, but they allow us to conclude that the differences in the reserves and in the composition of the air in the soil recorded during the experiments determine differences in the progress of the biological processes in the soil, which, working as a whole, give rise to the most favourable conditions for winter cereals. Considered from this point of view, the study of the æration of the soils of fallow land is as important as that of the movement of water in the soil.

The writer also made experiments on soils under summer cereals and on a number of factors influencing the composition of the air contained in the soil. Amongst these he studied: (a) the temperature; (b) the diffusion of gases in the soil; (c) the percolation of water in the soil; (d) the removal by wind of the air in the soil; (e) the formation of certain gases in the soil; (carbonic acid and other gases).

The outstanding fact is that of all the factors concerned in gaseous exchange, the percolation of water is the most active, but it only occurs during periods of rain. Thus, rapid changes in the composition of the air contained in the soil are only possible when it rains.

At the close of this article the writer gives full details of the method for determining the æration, porosity and absorptive capacity of the soil.—BULL. OF INT. INST. OF AGRIC.

INFLUENCE OF TILLAGE AND MANURES.

The maintenance of the soil in a high state of fertility is an essential condition of success in farming, in which respect the land does not differ greatly from the animals which feed upon it. The owners of racehorses and the exhibitors of cattle or sheep know that a long course of careful preparation, in which knowledge of the subject and skilful application are combined, is necessary to attain the object in view. It may be impracticable to treat the soil with the same regard to final detail, but the principle is the same. Bountiful crops cannot be raised by spasmodic methods, but they can be made reasonably assured by keeping the land in what the former calls "good heart," a term that conveys much to the practical mind.

Fertility can be preserved or encouraged in two ways—by efficient cultivation and the judicious use of manures. A third method might be mentioned, that of bare fallowing, which is still unequalled for handling the stronger clays and loams, but there will be little disposition voluntarily to adopt this course in the present crisis, the prevailing opinion being that all cultivable land should be made to contribute something to the needs of the nation.

The influence of good and seasonable cultivation can scarcely be overestimated. There is stored up in most land that has been long under the plough reserves of nutriment that can be made available as plant food through physical rather than chemical intervention. When the balances of constituents that make up the food of plants is considerably disturbed the use of chemical correctives may be essential, but it is astonishing what good tillage can do to cure disorders of the soil and to release nutriment formerly inaccessible. Systematic trials have been instructive on this point and evidence equally convincing is presented in the success of those who manage their holdings on this principle. The strong furrow noticeable in autumn tillages is the visible embodiment of the system. Much depends on the exposure of the soil to the full depth of its "improved" area to the ameliorating action of the winter forests.

SOMETHING THE ANCIENTS KNEW.

The use of vegetable and other fertilizers goes hand in hand with good cultivation. Practice and science are agreed that the manure heap is the chief source of fertilizing ingredients. The qualities of yard manure are no new discovery. Farmyard manure has been a vital element in preserving the productive capability of soils for countless generations. Its properties were as highly appreciated 2,000 years ago as they are to-day. This recognition is the root of the success of the industrious French peasants, who last month, undeterred by the absence of men and by depleted teams, were giving to their well-tilled plots the customary liberal top-dressing of manure, the work being done largely by women. The carting of manure is also a prominent source of employment in this country, but here more than in France, there is evidence that work has been restricted from want of labour. If this continues and the land be asked to respond to the national appeal, insufficiently aided by fertilizers, the result can scarcely fulfil expectations. The application of artificial manures is simple, but it cannot compensate for the absence of dung, which is almost as valuable for its equalizing and physical influence as for the nutriment it adds directly to the soil.—THE TIMES.

EXPERIMENTS ON THE APPLICATION OF SULPHATE OF AMMONIA.

L. MALPEAUX.

The soil chosen for these experiments was a uniform loam in good condition, which had been dug two spits deep. At the beginning of April the writer marked out six adjacent rectangular plots, which were then dressed as evenly as possible with sulphate of ammonia at the rate of 360 lb. per acre dug in at varying depths from 2 to 12 inches.

A portion of the same side of each plot was reserved without crop and the whole of the remainder sown with sugar-beets. The thinning out was carefully done so as to leave the same number of plants in each plot. Samples of soil were taken to a depth of 16 in. simultaneously in both cultivated and bare ground on June 30, July 31, and August 29, and the percentage of nitric nitrogen was determined by the colorimetric method.

The detailed results of these analyses are summarised as follows:—

On bare land the variations are of small extent in the control plots, which only yielded for determination nitrates resulting from the nitrification of humus in the soil. The maximum figures occur in the zone from 4 to 8 in. and from 8 to 12 in. The same result was also found in all plots where the manure was buried. Where sulphate of ammonia was applied as a top-dressing the greatest proportion of nitric nitrogen remained in the upper 4 in., a circumstance which is obviously unfavourable to its rational use by a tap-rooted plant like the beet. The results for the total amount of nitric nitrogen of each plot receiving nitrogenous manure agree sufficiently to show that in no case was there any loss of nitrate. Even where the sulphate of ammonia was not most deeply buried, the maximum amount of nitrate is found in the zone between 8 and 12 in. deep. Thus the combined influences of rain and capillarity cause the ascent of soluble manure towards the surface.

Since the manure did not leave the 16 in. layer, the variations in the total amount and proportions of nitric nitrogen for each plot of beets can only be due to the absorption by plants. Consequently the differences in the figures of corresponding plots in bare soil give a measure of the relative quantities of nitrogen consumed by the plants. Whilst the control plot was only able to supply 5 mgms. of nitric nitrogen per 100 mgs. of dry earth, the manure had provided 6·8 when applied as a top dressing, 7·7 when buried at a depth of 2 in., 9·5 at a depth of 4 in., 8·8 at 7 in., and 9·1 at 12 in. It is thus easy to see that the best use of the manure is obtained by burying to a depth of at least 4 in.

This conclusion is supported by the results of the weighing and analysis of the roots from each plot, as shown in the following table:

No. of plot.	Sulphate of ammonia applied at:	Yield in cwt. per acre.		Density at 15°C.	Percentage of sugar in juice.	Purity.	Percentage of sugar in roots.	Yield of sugar per acre.
		Leaves	Roots					cwt.
1.	Control	282	226	7·4	16·87	86·8	14·53	32
2.	Surface	469	274	7·0	15·54	84·5	13·52	37
3.	Depth of 2 in.	457	282	7·1	15·90	84·7	13·81	39
4.	,, ,, 4 ,,	465	389	7·4	16·23	82·8	14·07	55
5.	,, ,, 7 ,,	471	358	7·1	15·98	85·0	13·88	50
6.	,, ,, 12 ,,	477	356	7·2	16·55	86·9	14·36	51

The manure applied as a top-dressing or simply dug in to a depth of 2 inches was later in action than in the other plots. Growth was prolonged and there was a predominance of leaf development over that of the roots, especially in the autumn. The greatest yield was obtained with manures dug in to a depth of 4 inches, but the results of the plots dug to a depth of 7 and 12 inches were also very satisfactory.—BULL. OF INT. INST. OF AGRIC.

ENTOMOLOGY.

SHOT-HOLE BORER OF TEA.

DISCUSSION AT THE COMMITTEE OF AGRICULTURAL EXPERIMENTS, PERADENIYA, NOVEMBER 11, 1915.

MR. SPEYER gave the results of some experiments to illustrate the relation of the attack of Shot-Hole Borer Beetle to the general conditions under which Tea is cultivated in Ceylon.

These experiments had, for their basis, observations made while gathering information on estates in the Province of Uva, a district, therefore, to which the results must have their limit on application.

These were :—

(1.) In fields which have run 2–6 months from pruning, the number of trees attacked by Shot-hole is almost negligible, whereas there is an increase in the number of trees infested for the ensuing months up to the time of pruning—for instance, at the end of two years from the last pruning.

(2.) Without exception—as far as experience has gone—there are always some trees left unattacked at the end of two years, no matter how severe the attack in surrounding individual bushes may be at the time.

(3.) A definite, and sometimes rapid, increase of attack results in fields which have run 10–16 months from pruning, at a time, more or less coinciding with the pruning of fields which have run 2 years. To afford reasons for these observations, three experiments were performed on a similar line of procedure, where a number of trees were selected, surrounded on all sides by tea-bushes containing shot-hole borer. In all three, a portion of a field was selected, containing a known number of bushes. The bushes were examined and a record taken of those bushes which were infested. From the latter, in Experiments 1 and 2, all beetle galleries, contained by the bushes, were removed and the area exposed to further attack by beetles flying from the surrounding tea, for a known period of time. At the end of this period, the same process would be repeated, and the area likewise left exposed to attack for another period, and so on, as shown in the two tables given.

In Experiment 3, however, instead of removing the shot-hole borer, the bushes were pruned, not with a view to removing the beetle-galleries, but with a view to ensuring the out-put of shoots within a reasonable space of time. A bush thus pruned in one period would often contain a number of entrance holes in the collar. These holes were counted at the end of each period, in each bush containing them, and if more holes were present in one period than in the period preceding, this bush was marked down as reinfested. If, on the other hand, the same number of holes were found, then the bush was marked as left unattacked during that period.

Experiment 1. Number of trees used for experiment, 257 : bushes, large ; health, good ; ground, level ; elevation, 2,800 ft. Pruned last, July 1913. Due for pruning, July 1915. Experiment started 21 months from previous

pruning; 3 months from future pruning.

Period.	Duration Days.	Trees attacked.	Trees revisited.	Trees newly attacked.	Trees previously attacked left unattacked	Trees never attacked previously.
To April 24 ...	—	93	—	—	—	164
1. April 24-May 8...	14	77	58 (75 %)	19 (25 %)	35	145
2. May 8-May 28...	21	70	54 (77 %)	16 (23 %)	58	129
3. May 28-June 18	21	61	46 (75 %)	15 (25 %)	82	114
4. June 18-July 1 ...	14	66	57 (86 %)	9 (14 %)	87	105 (40 % of total

Experiment 2. Number of trees used for experiment, 41 : bushes, small; health, poor; ground, sloping steepily; elevation, 4,300 ft. Pruned last, August 1914. Due for pruning, August 1916. Experiment started 11 months from previous pruning; 13 months from future pruning.

Period.	Duration Days.	Trees attacked.	Trees revisited.	Trees newly attacked.	Trees previously attacked left unattacked	Trees never attacked previously.
To July 12 ...	—	10	—	—	—	31
1. July 12-20 ...	8	9	6 (69 %)	3 (31 %)	4	28
2. July 20-28 ..	8	11	6 (54 %)	5 (46 %)	7	23
3. July 28-Aug. 8...	10	6	3 (50 %)	3 (50 %)	15	20
4. Aug. 8-Oct. 14...	57	13	7 (54 %)	6 (46 %)	14	14
5. Oct. 15-30 ...	16	7	7 (100 %)	0 (0 %)	20	14 (34 % of total

These two experiments show clearly that :—

(1) Shot-hole borer beetle, either by instinct or the process of trial and error, attacks trees which have previously been the subject of attack.

(2) A number of trees (in Experiment 1, 40 %) are never visited by the beetle.

The results lead one strongly to believe that the bushes gradually attain a state in which they invite attack the longer they run from the last pruning, and that some bushes hold out against the beetle longer than others; a considerable number, indeed, for the whole period between two prunings, 2 years on good soil, and a smaller number on poor soil.

The figures of Experiment 2 are not so striking as those of Experiment 1 for two reasons, namely, that the number of trees used was much smaller, and the bushes, being smaller, in some cases at any rate, presented the

appearance of having been pruned in the later periods, owing to the number of branches which it was necessary to remove in extracting the shot-hole galleries. The latter point, however, acts to a considerable extent in con firming Experiment 3.

It is established, then, that an immunity exists in the tea-bush, which is lost sooner by some bushes than by others after pruning.

The next experiment shows the exact effect of pruning upon thus rendering the trees immune for a certain period of time.

Experiment 3. Number of trees used for Experiment, 41: bushes as in Experiment 2, and adjoining the same.

In periods 1 and 2, bushes merely pruned when found infested.

In periods 3 and 5, bushes treated as in Experiments 1 and 2.

Period.	Duration Days.	Trees attacked.	Trees revisited.	Trees newly attacked.	Trees previously unattacked.	Trees never attacked unpruned.
To July 12 ...	—	11	—	—	—	30
1. July 12-20 ...	8	7	4 (57 %)	3 (43 %)	7	27
2. July 20-28 ...	8	7	0 (0 %)	7 (100 %)	14	20
3. July 28-Aug. 8...	10	12	2 (17 %)	10 (83 %)	19	10
4. Aug. 8-Oct. 14...	57	5	2 (40 %)	3 (60 %)	28	7
5. Oct. 14-Oct. 30	16	2	2 (100 %)	0 (0 %)	31	7 (17 % of total

It will at once be recognised that, as compared with the last two experiments, the proportion of trees revisited to those newly attacked in each period is practically reversed, except in the last two Periods, where the bushes received the same treatment as in the first two experiments.

This means that the pruned bushes, instead of inviting attack after the first infestation, attained an immunity similar, perhaps, to that exhibited by 40% and 37% respectively of the trees in Experiments 1 and 2. The exact effect of this pruning is best shown by reference to the column of figures in each Experiment indicating the number of trees in each period which were left unattacked after having been infested in a preceding period. To illustrate this, the proportion of these trees to those revisited is given in percentages.

In Experiment 1.

Period.		Trees revisited.		Trees previously attacked left unattacked.
1.	...	62	...	38
2.	...	49	...	51
3.	...	36	...	64
4.	...	40	...	60

In Experiment 2.

1.	...	60	...	40
2.	...	47	...	53
3.	...	17	...	83
4.	...	34	..	66
5.	...	26	...	74

In Experiment 3.

1.	...	36	...	64
2.	...	0	...	100
3.	...	10	...	90
4.	...	10	...	90
5.	...	9	...	91

In Experiment 1 and 2, the figures are strikingly similar, the proportions becoming gradually reversed owing to there being a greater number of trees attacked once or more in each successive period (for instance in Exp. 1. Before Period 1. 93, in Period 1. 93 + 19 = 112, and so on), thus providing a bigger choice in each instance.

In Experiment 3, on the other hand, the preponderance of trees left unattacked over those revisited is remarkable, and is merely due to the effects of pruning. Those trees which had been pruned before Period I. began to give best evidence of their immunity about the time of Period 3., when the shoots were putting out an abundance of leaves, and at the end of the experiment, which had lasted 3½ months, 100% of the pruned trees had become immune, even though the galleries of the beetle had not been removed from them, save in the branches.

At the beginning of the Experiment, however, the effect of the pruning, on the trees first found attacked, had not made itself apparent.

An examination of the 257 trees of Experiment 1, made on October 24th—4 months after natural pruning—showed not a single beetle present in any of the bushes, and evidence is forthcoming, but must be deferred, that the beetles are actually forced to leave their galleries in the lower parts of the bushes after pruning.

In those branches which put out no shoots after pruning, however, this is not the case. It is therefore highly advisable to remove these branches from a field within 4 months after pruning.

Finally, tea grown under exceptionally poor conditions does not seem to conform to an establishment of immunity to the extent which is noticeable in healthy, well-manured fields.

The exact causes which produce this immunity will form the subject of a future report, if, indeed, it will be found possible to give a satisfactory explanation of them.

Note—The above differs somewhat from the account actually given by MR. SPEYER at the meeting but the figures are exactly the same though the interpretation of them is simpler, and the conclusions drawn from them remain the same as those actually given at the meeting.

MR. WILKINS asked MR. SPEYER if he had any idea as to why certain bushes or parts of fields appeared to be immune? Whether rainfall or manure had any influence?

MR. SPEYER replied that the actual reason for immunity was not at present possible to give, but that natural immunity might well be the same as that produced by pruning, therefore in which case a mere increase in the flow of sap might be the cause of such immunity. At the same time, manuring and sap-flow must be closely co-ordinated as a general outcome of the health of the plant.

MR. COOMBE said that he thought this season had been an unfortunate one for MR. SPEYER's experiments owing to the unusual and continued wet weather—no prolonged drought having been experienced.

MR. SPEYER defended the result of his experiments on the ground that they were comparable within themselves.

MR. COOMBE thought that the point that those branches that did not sprout after pruning and which generally died, almost invariably contained beetles, was an important one. Something might be done by cutting these out and burning them.

MR. SPEYER said that his method had been originated by MR. D. S. CAMERON and put into practice with good results.

MR. PATTERSON asked MR. SPEYER his opinion as to hard pruning at long periods as compared with lighter pruning at shorter periods?

MR. SPEYER replied that he strongly deprecated hard pruning of any kind with intent to get below the beetle galleries. The immunity produced by a pruning suitable to the requirements of the bush, was entirely sufficient to produce a temporary immunity. A hard pruning on a bush which did not require it, was therefore defeating the object in question.

MR. TISDALL asked if the beetles were found only in the branches.

MR. SPEYER replied that they were also found in the stem and even in the stem under the ground, but not in the roots.

MR. COOMBE enquired whether MR. SPEYER had arrived at any conclusion as to the burning of the prunings.

MR. SPEYER replied that at present he would advocate half measures, that is slashing off the green leaves and light twigs which do not generally contain beetle, to be returned to the soil as humus and burn the stems which form the principal home of the borer. But he would like to enquire whether this was practicable.

MR. HUYSHE ELIOT replied that this was the common practice on some estates where the cost worked out at about Rs. 2 per acre.

MR. WILKINS strongly opposed burning prunings as it robbed the soil of valuable humus. In his opinion high cultivation would give a good yield in spite of borer.

MR. SPEYER strongly supported the latter part of MR. WILKINS' remark.

MR. T. Y. WRIGHT said he had collar-pruned a field badly infected and burnt all the prunings, with the result that there was an excellent flush and only a little borer to be found.

MR. SPEYER intimated that similar results might have been obtained by less drastic measures.

COCONUT BEETLES.

MR. F. W. URICH, in a paper read before the Agricultural Society of Trinidad, enumerates the different beetles attacking the coconut palm.

Oryctes rhinoceros, the rhinoceros beetle of the East occurring in Ceylon, India, the Dutch East Indies, Philippines, Samoa, Straits Settlements and F. M. S., which in the adult stage attacks the palm for food, boring into it through the central bud, feeding on the soft tissues and also paving the way for other insects as well as fungi.

Other species of Oryctes occur in Madagascar and Africa and work in the same way.

In the West Indies *Strategus alœus* is the chief beetle pest of young coconuts. The adult burrows in the ground, enters the palm from below and works up to the tender tissues of the bud.

S. julianus is another species which attacks pineapples.

Phileurus aidymus has been observed on trees which have succumbed to budrot.

Enema endymion is said to attack coconut palms like Strategus alœus.

Parselus internuptus is described as a scavenger pure and simple, living in decaying wood of any kind.

RICE PESTS.

1. THE RICE WEEVIL *(CALANDRA ORYZÆ.)*

This small weevil belongs to the order Coleoptera or the Curculionid family. It is considered as being indigenous to the East whence it has spread all over the world. It causes great damage to cereals such as rice, wheat and maize.

Life History.—The adult measures 3 to 4 mm. in length and 1 mm. in width and varies in colour from deep brown to ferruginous brown. The elytra are adorned with four distinct reddish spots situated obliquely at its base and tip; these spots, however, are sometimes missing or feebly indicated.

The body is densely punctured: the elytra are deeply striated longitudinally and loosely covered with short, rigid and yellowish hairs.

The head which is as big as the thorax is prolonged into a sort of snout.

The antennæ are elbowed and longer than the proboscis.

The larva is a small white grub, fleshy, wrinkled and legless, and is as long as it is large. The chrysalis or nymph is also white and transparent and exhibits the general characteristics of the adult insect.

By means of her rostrum, the female bores a small hole in the grain where she lays one egg. Several eggs are laid, as a rule, in the maize grain as it contains sufficient food for several larvæ.

A few days after they have been laid, the eggs hatch out and the young larvæ eat their way through the grain, which is soon reduced to dust. When they are full-grown, the larvæ measure 2 to 2½ mm. long and change to the nymphal state, during which period the ultimate transformations take place.

The adult insect can live a long time, varying from three to five months according to season and climate, and is on account of its longer period of life much more injurious than the larvæ.

In this colony, the evolution of this species lasts about 30 to 40 days; it is shorter in summer than in winter and varies with localities. The number of generations annually produced varies from 6 to 8 on the sea coast; on the higher districts, it is probably less.

This weevil is not peculiar to rice as its name seems to imply. Although it is very common in both rice and maize, it is not less injurious to all cereals and has even been commonly recorded as being injurious to various foodstuffs such as macaroni, biscuits, etc.

The weevils reared from rice are as a rule smaller and of a lighter colour than those from maize. The yellowish red spots on the elytra are not so often missing.

Rice often arrives from India infested with this weevil. It is not uncommonly considerably damaged and rapidly becomes unfit for consumption.

Remedial Measures.—No serious attempt has ever been made up to the present for ridding buildings in which rice is stored of this pest. The insects are to be found swarming on the bags and crawling over the walls.

A thorough treatment with either carbon bisulphide, hydrocyanic gas or sulphur dioxide would necessitate the opening of the bags, the spreading of the grain in thin layers on the flour and its repacking. These operations, which would have to be repeated at least twice yearly, would necessarily entail an expenditure that would not be recouped if the losses the merchants have been used to consider as unavoidable are taken as the basis for calculation.

The disinfection carried out by the Medical Department against rats by means of sulphur dioxide generated by a Clayton apparatus has, however, given excellent results, and if it were frequently repeated it would undoubtedly reduce considerably the damage done by this insect.

Owing to local conditions, such as situation of the stores in the commercial centre of the town, the narrowness of the stores when compared with the enormous quantities of grain they contain, and the different varieties of grain in sewn bags, which render carbon bisulphide and hydrocyanic gas treatments very expensive, the sulphur dioxide gas method seems to be the most practical and economical one in spite of the limited penetration of the gas.

11. THE RICE MOTH (*EPHESTIA CAHIRITELLA.*)

This insect is a small moth of the family of the Phycitidæ and is spread all over the world.

In India, where it is extremely common, it attacks especially rice and flour. In Egypt and in America, where it has been named the dried-currant moth, it attacks most of the dried fruits, such as raisins, currants, and figs. It also attacks almonds, nuts, and cacao-beans. In this country it has a marked liking for the white Saigon and Rangoon rices. Other kinds of rice are seldom attacked.

Life History.—At rest the wings are folded round the body; when expanded, they measure about 20 mm. The fore-wings which are much narrower than the hind ones, are lead grey in colour with more or less suffused brown markings, more conspicuous on the longitudinal veins. The hind wings are of a uniform dirty white colour and are bordered with a large fringe of the same colour. The whole body is grey.

The caterpillar measures from 10 to 12 mm.; it varies from dirty white to yellowish and bears on its segments short and rigid hairs. It lives inside a sort of silky sheath made of spun-up grains in which it spends its whole life.

The chrysalis measures 8 to 10 mm.; it is reddish brown and is enclosed in a white silky cocoon.

These insects are not only injurious on account of the quantity of grains they consume, but specially on account of the unsaleable state to which they reduce the grains, as they leave in it their excreta, their nymphal envelopes together with the spun-up grain.

The removal of this waste is a laborious operation which entails much labour and necessitates an expenditure much above the cost of the actual damage done by the insects themselves.

Remedial Measures.—The moths are to be found resting on walls and on the bags of the stores, where they can be easily destroyed by carbon bisulphide or any other insecticide.

The refuse coming from the infected rice, which always contains live larvæ and chrysalides and eggs, should not be simply thrown away. It should always be carefully burnt. Repeated applications of carbon bisulphide, and destruction of all refuse, would rapidly get rid of this pest and the expenditure involved would not be great.—BULL. No. 2, DEPT. OF AGRIC., MAURITIUS.

FOOD OF AZOTOBACTER.

F. L. MOCKERIDGE.

In order to discover how far *Azotobacter* is capable of utilizing the wide range of organic compounds which occur in soil, cultures of the organism were inoculated into series of media made up of various organic substances and mineral salts. The organic substances in question included humates, polysaccharides, sugars, alcohols, the calcium salts of organic acids, esters, glucosides and benzine derivatives.

In the case of the humates, growth was only obtained when the organic matter was supplied as ammonium humate and no nitrogen was fixed. The availability of the glucosides was restricted somewhat by the products of their decomposition, and the benzine derivatives proved totally unable to provide a source of energy for *Azotobacter*. The presence of either of these two latter classes of compounds, however, never inhibited growth on manitol-agar plates. The carbohydrates tested showed themselves in general to be readily available sources of food for *Azotobacter*. The returns of nitrogen fixed for the expenditure of food material varied considerably and the rule seemed to be that the longer the time taken to use completely a unit mass of the nutrient, the less nitrogen was fixed upon that medium.

Considering the wide range of compounds which *Azotobacter* proved itself capable of assimilating, it is evident that any ordinary soil must contain abundant food material for the growth of the organism.—BULL. OF INT. INST. OF AGRIC.

GENERAL.

CEYLON AGRICULTURAL SOCIETY.

MEETING OF 30TH NOVEMBER, 1915, AT GALLE.

Minutes of a meeting of the Board of Agriculture held at Galle Kachcheri, on Tuesday the 30th November, 1915, the Hon'ble the Government Agent (MR. R. B. HELLINGS) presiding.

There were also present:—MR. R. N. LYNE (Director of Agriculture) MR. M. KELWAY BAMBER (Government Agricultural Chemist), MR. D. S. CORLETT (Manager, Experiment Station, Peradeniya), MR. L. E. CAMPBELL (Rubber Research Chemist), MR. G. M. HENRY (Asst. Government Entomologist), MR. GEO. BRYCE (Acting Botanist and Mycologist), MR. T. H. PARSONS (Curator, Royal Botanic Gardens, Peradeniya), MR. B. F. SCHERFFIUS (Tobacco Planter), VERY REV. FATHER J. COOREMAN, S.J., REV. FATHER PAUL COOREMAN, S.J., MR. PAUL E. PIERIS, DR. E. LUDOVICI, DR. J. B. LOURENSZ, MR. AND MRS. R. L. EPHRAUMS, Mudaliyars J. P. GOONETILLEKE, E. B., GOONETILLEKE, O. TILLEKERATNE, HARRY JAYAWARDENE, E. V. GOONERATNE, T. W. GOONEWARDENE, H. D. PERERA; Proctors M. S. GOONERATNE and D. W. SUBASINGHE; MESSRS. H. AMARASURIYA, N. A. S. JAYASURIYA, T. W. GOONEWARDENE, Jnr., T. P. ABEYEWICKREME, E. L. DANIEL, President P. B. HERAT, and a large number of headmen from the Wellaboda, Gangaboda and Talpe Pattus, as also headmen of the Gravets, and the Secretary (MR. C. DRIEBERG).

A meeting of the Committee of the Board was held prior to the meeting of the Board at which MR. CORLETT brought up the subject of the advantages of the Drain and Canal system of paddy cultivation as a means of controlling the water supply. Considerable discussion ensued.

The meeting of the Board followed. The Secretary read the Minutes of the meeting held on 25th May, 1915, at Kandy, which were duly confirmed.

Progress Report for the quarter ending November was read and adopted.

Statement of Expenditure to end of October was tabled.

At the Meeting of the Society which followed MR. AMARASURIYA read his paper on "Notes on Coconut Cultivation in the Southern Province." In the course of the discussion which followed MR. BAMBER said the idea that artificial manure exhausted the soil and shortened the life of the tree was fallacious. Intelligent manuring on the other hand lengthened the life of a tree. MR. PAUL PIERIS and MUDALIYAR GOONETILLEKE also offered remarks.

MR. SCHERFFIUS read a short note on Tobacco: Estimates, Profits, Yields, etc., for Ceylon. MR. PAUL PIERIS and MR. AMARASURIYA joined in the discussion which followed.

The Director in summing up the proceedings advised that one or two young men should be sent to study the methods adopted at the Tobacco Station, so that the Southern province may benefit by the knowledge acquired by them. He said that paddy experiments on the lines followed by MR. CORLETT will be demonstrated at Hambantota. He invited some of those present to visit Jaffna to see the work that is going on there.

A vote of thanks to the chair terminated the proceedings.

C. DRIEBERG,
Secretary, C.A.S.

HORSE FOOD.

THE HORSE AND MECHANICALLY DRIVEN VEHICLES.

In many parts the horse still holds its own against mechanically driven vehicles. The initial cost and the uncertainty of cost of upkeep along with an ignorance and fear of mechanics keeps many from taking the initial step in changing their mode of locomotion from oats to petrol. Where roads are poor, jungle tracks and rough country have to be traversed, the horse is supreme; such conditions obtain on many estates, where, if supervision is to be thorough the horse is necessary. The horse can go most places cars and cycles cannot. The recent riots showed up the immobility of car and cycle, where bridges were destroyed; and other methods could have been used to render mechanically driven vehicles still less mobile. Under these conditions, districts could have been isolated and devastated by the mob; valuable estates and properties which had cost the owners much capital could have been ruined long before military aid could have been obtained. The only saviour of such an imaginary situation would have been mounted troops, whose mobility is difficult to destroy. They go like water, anywhere. If such situations are to be avoided Government will require a certain number of horses to be kept in the Island for military purposes. The horse has by no means passed its usefulness, and if stables are to be kept it is necessary to consider the cheapest and best method of feeding, to regulate stable account.

CAUSES OF RISE IN PRICES.

A comparison of prices of horse food pre-war days with the prices regulating now shows there has been a marked increase of price. The war has closed down ports and markets, monopoly by Governments have come into existence as with other produce, shortage of freight has raised the cost of carriage, and embargoes made by countries to preserve their supplies have all tended to raise the price of horse-food.

Table 1.

VOLUME, WEIGHTS AND PRICES.

No.	Name of Sample.	Weight grams.	Weight lb	lb. Meas.	No. of Measures per bag of 108 lb.	Price per bag 1915.	Price per bag 1912.	Increase o/o in Price.
1	One cut. Measure Gram whole	814	1·97	100=50·7	55	Rs. 8·00	Rs. 6·50	23·08
2	,, ,, ,, ,, crushed	676	1·49	,, =67·0	72	,, 8·25		
3	,, ,, ,, Paddy whole	630	1·53	,, =65·3	72	,, 6·35	,, 6·00	5·83
4	,, ,, ,, ,, crushed	493	1·2	,, =83·3	90	,, 6·60		
5	,, ,, ,, Australian Oats whole	541	1·31	,, =76·3	79	,, 15·00	,, 8·75	71·43
6	,, ,, ,, Australian Oats crushed	349	0·84	,,=119·0	128	,, 15·25		
7	,, ,, ,, Indian oats whole	488	1·18	,, =84·7	89	,, 10·00		
8	,, ,, ,, Indian oats crushed	316	0·77	,,=130·0	138	,, 10·25		
9	,, ,, ,, Australian Bran	225	0·54	,,=185·0	193	,, 12·35	,, 6·50	90·00
10	,, ,, ,, Indian Bran	200	0·48	,,=208·0	216	,, 7·00	,, 5·50	27·27
11	,, ,, ,, Australian Chaff	163	0·39	,,=250·0	*215	,, 11·00		
12	,, ,, ,, Indian Chaff	97	0·23	,,=435·0	*366	,, 6·50		

* 84 lb. bags.

N.B.—1 Bushel=8 gallons=32 Quarts (or Measures) 1 Measure full of water weighs 2¼ lb. nett.

CRUSHED AND UNCRUSHED FOODS.

On looking over the above table it will be noticed that crushing gram reduces the weight of a measure by 25%, paddy by 20%, Australian oats by 33%, Indian oats by 35%. So that if crushed food is ordered, the ration should be increased by that proportion for the several foods to make it up to the uncrushed material. Where long distances have to be covered from merchant to stable, uncrushed food will be the easier to handle in carriage but should be crushed before using, to facilitate digestion.

INDIAN AND AUSTRALIAN FOODS.

Comparing Indian material with Australian, it is noted that Indian food is lighter than the Australian. Indian Bran is 10% lighter than Australian Bran, Indian Chaff is 40% lighter than Australian Chaff, Indian Oats is 10% lighter than Australian Oats. To get the equivalent weight of Indian food to Australian food, the Indian food must be increased by the above proportion for the several foods.

PRESENT PRICES.

Comparing the prices in above table, it will be seen there is an increase of from 6-90% in price and that the greatest increase is on Australian produce, especially Oats and Chaff.

VALUE OF A FOOD.

The value of a food can be deduced from an analysis, true value for the individual animal by trial. A table of food and analyses are given below:—

Table 2.
HORSE FOOD ANALYSIS.

	Australian Bran	Indian Bran	Australian Chaff	Indian Chaff
Moisture	13·5 %	13·0 %	14·0 %	11·0 %
Ash	4·7 ,,	6·0 ,,	3·9 ,,	10·3 ,,
Oil	2·8 ,,	2·9 ,,	4·3 ,,	1·8 ,,
Woody-Fibre	8·3 ,,	10·8 ,,	22·0 ,,	29·4 ,,
Proteids	13·5 ,,	13·1 ,,	7·1 ,,	2·2 ,,
Carbohydrates	57·2 ,,	54·2 ,,	48·7 ,,	45·3 ,,
	100·0	100·0	100·0	100·0
Nitrogen	2·16 %	2·1 %	1·13 %	0·35 %
Nutrient ratio	1:4·7	1: 4·6	1: 8·4	1:22·6
Food-units	97·95	94·2	77·2	55·3
Price per Bag 108 lb.	Rs. 12·35	Rs. 7·0	Rs. 11·0*	Rs. 6·50* (*84 lb.)
Price per Food-unit	Rs. 0·12	Rs. 0·07	Rs. 0·17	Rs. 0·14

	Australian Oats	Indian Oats.	Paddy	Indian Gram
Moisture	12·5 %	11·8 %	12·3 %	11·5 %
Ash	2·3 ,,	3·1 ,,	4·6 ,,	2·6 ,,
Oil	6·3 ,,	6·6 ,,	2·9 ,,	4·8 ,,
Woody-Fibre	8·7 ,,	14·9 ,,	8·6 ,,	6·8 ,,
Proteids	12·3 ,,	10·9 ,,	6·6 ,,	20·5 ,,
Carbohydrates	57·9 ,,	52·7 ,,	65·0 ,,	53·8 ,,
	100·0	100·0	100·0	100·0
Nitrogen	1·96 %	1·74 %	1·06 %	3·28 %
Nutrient ratio	1:6	1:6·3	1:10·9	1:3·3
Food-units	104·4	96·5	88·8	117·1
Price per Bag 108 lb.	Rs. 15/-	Rs. 10/-	Rs. 6·35	Rs. 8/-
Price per Food unit	Rs. 0·13	Rs. 0·10	Rs. 0·06	Rs. 0·06

Table 3.

COMPARISON OF UNCRUSHED FOODS IN FOOD-UNITS, WEIGHTS AND VOLUMES.

Proportion of Food-Units.	Weights in Lbs.	Weights in Lbs.
Paddy : Gram :: 88·8 : 117 1	100 Gram = 132 Paddy	100 Paddy = 75·7 Gram
Aust. Oats : Gram :: 104·4 : 117·1	100 Gram = 112 Australian Oats	100 Aust. Oats = 89·5 Gram
Indian Oats : Gram :: 96·5 : 117·1	100 Gram = 121 Indian Oats	100 Indian Oats = 82 2 Gram
Paddy : Aust. Oats :: 88·8 : 104·4	100 Aust. Oats = 118 Paddy	100 Paddy = 85 Australian Oats
Paddy : Indian Oats :: 88·8 : 96·5	100 Indian Oats = 110 Paddy	100 Paddy = 92 Indian Oats
Indian Bran: Indian Oats :: 94·2 : 96·5	100 Indian Oats = 102·4 Indian Bran	100 Indian Bran = 97·8 Indian Oats
Paddy : Indian Bran :: 88·8 : 94·2	100 Indian Bran = 106 Paddy	100 Paddy = 94·2 Indian Bran
Gram : Indian Bran :: 117·1 : 94·2	100 Gram = 124 Indian Bran	100 Indian Bran = 80·4 Gram

Volume in Measures.

100 Paddy = 59·2 Gram; 100 Gram = 169 Paddy
100 Gram = 168 Australian Oats; 100 Australian Oats = 61 Gram
100 Gram = 200 Indian Oats; 100 Indian Oats = 50 Gram
100 Aust. Oats = 101 Paddy; 100 Paddy = 99 Aust. Oats

Volume in Measures.

100 Indian Oats = 86 Paddy ; 100 Paddy = 117 Indian Oats

100 Indian Oats = 251 Indian Bran ; 100 Indian Bran = 40 Indian Oats

100 Indian Bran = 33·3 Paddy ; 100 Paddy = 300 Indian Bran

100 Indian Bran = 20 Gram ; 100 Gram = 505·7 Indian Bran

EXPLANATION OF TERMS, FOOD-UNITS, NUTRIENT-RATIO.

In the above table the various constituents may require explanation to the layman. The ash, less any sand there may be, is the bone-forming material, and is essential to the animal's welfare for the various salts required in building up the body and causing the organs to perform their functions properly. The oil or fat and carbohydrates are fat producing; the proteids are flesh forming; the woody fibre is the indigestible matter. The various complex bodies, simply expressed, are broken down by the animal's digestion process and elaborated by metabolism into flesh, bones, fat, blood, and heat or work in which so much is dissipated according to the amount of work done. Converting these various constituents into food units it is necessary to multiply the sum of the percentage of oil and albuminoids by 2·5, to obtain the carbohydrate equivalent, and add the figure obtained to the percentage of carbohydrates. Thus in Australian oats the total food units in 100 parts by weight are :—

Oil ...	6·3	Carbohydrate
Proteids ...	12·3	equivalent
	18·6 × 2·5 = 46·5	
+ Carbohydrates	57·9 = 104·4 Food Units	

If the various food units, per 100 lb., calculated above, be taken and the price per 100 lb. of food be also calculated, the price of I food-unit can be found. These are given above. On comparing the prices per 1 food-unit for the various foods it will be seen that the Indian foods are much cheaper per unit than the Australian foods. Indian bran is to the Australian bran as 7 : II in price per food unit ; Indian chaff is to Australian chaff as 14 : 17 ; Indian oats is to Australian oats as 10 : 13. That is taking into consideration the composition and the price; if the composition were taken into consideration alone the Australian food has per 100 lb. more food units, thus Indian Bran is to Australian Bran as 94·2 : 97·95, Indian chaff is to Australian chaff as 55·3 : 77·2, Indian oats is to Australian oats as 96·5 : 104·4. The cheaper Indian foods bring the price per food unit down to a cheaper food unit than that of the Australian food units.

To compare the various foods amongst themselves the ratio between the protein matter and the fat, starch, and sugars, etc., must be obtained ; this is called the "nutrient ratio" and is important along with the food-units in the study of foods. Take for example gram—the nutrient ratio is found by adding the carbohydrates to the carbohydrate equivalent of the fat (found by experiment to be fat × 2·5) and finding the ratio of the proteids to this figure obtained,

53·8 + 4·8 × 2·5 = 65·8.

Nutrient Ratio. 20·5 : 65·8 : : I : 3·2.

A narrow ratio is where the ratio approaches I : 4, a broad ratio I : 8; the former ratio is used in feeding animals which are undergoing hard work, the latter where fattening of cattle is taking place for market purposes. The ratio I : 3 indicates a strong food containing much proteids in proportion to the fats

and carbohydrates and requires to be mixed with foods containing more carbohydrates and fats to reduce the ratio.

COMPARISON OF AUSTRALIAN AND INDIAN FOODS.

Australian Bran compares favourably with Indian Bran. It has less woody-fibre than Indian Bran but the nutrient ratio is practically the same and as the price is as 12 : 7 the price per food unit is more for Australian Bran, namely 12 cents, to the Indian Bran 7 cents : all is in favour of Indian Bran.

Indian Chaff is inferior in quality to Australian chaff, weight for weight, containing more woody-fibre and less of the feeding qualities, namely fat, proteids and carbohydrates, but still due to the cheaper rate charged for Indian Chaff, the price per food unit is less than that for Australian chaff. Indian Chaff as a food is poor, having a poor nutrient ratio. Referring to an old analyses of Ceylon Paddy straw it appears that it is superior to Indian chaff having a nutrient ratio of 1 : 17 and 57·4 food units per 100 lb., so chopped Paddy straw would be better and cheaper as a food filler or dilutant to the richer foods than Indian Chaff.

Indian Oats are inferior to Australian Oats having more indigestible matter, and less of the true feeding material. The nutrient ratio is similar. Indian oats are cheaper per unit. Comparing Indian Oats with Indian Bran it should be noted that the former has 96·5 food-units, the latter 94·2 food units, and the price is Rs. 10/- against Rs. 7/- for 108 lb. Considering the similarity between the number of food units and the difference in price it might be said that Indian Bran is a better food than Indian Oats. The price per food-unit is 7 cents in the case of the Bran, 10 cents in the case of the Oats.

Paddy has a broader nutrient ratio than oats, is lower in proteids and fat but richer in carbohydrates. The total food-units are less, 88·8 compared with Australian oats 104·4, Indian Oats 96·5 ; the price per food unit is 6 cents compared with Australian oats 13 cents and Indian oats 10 cents.

Gram is a rich food having a narrow nutrient ratio, is richer in proteids than oats or paddy and has less indigestible matter. The food-units per 100 lb. are 117 compared with Australian oats 104 and Paddy 89, and should be given in the diminished proportion of 117 : 104 if gram is substituted for a portion or the whole of the oats, and in the proportion 117 : 89 if substituted for the whole or a portion of the paddy. 10 lb. of gram per diem is the maximum for this food, as it is heating. The price per feeding unit is the same as price per feeding unit of paddy.

Australian horse food is richer than Indian horse food ; bulk for bulk it is heavier ; per food unit it is dearer.

RATION.

To make up a ration from the tables, taking as a basis that a daily ration is 20-30 lb., according to the work to be done, of which half is oats the remainder hay, or in this country chaff, bran and grass, 10 lb. oats=11·8 lb. paddy; dividing this up into paddy and gram in the ratio of their nutrient ratios it will be found equal to 5-5·5 measures of paddy and 2-2⅓ measures of gram, 7½ measures uncrushed hard food per day for the horse in moderate work; this can be lessened or increased as the work is less or greater. A daily ration of 4½ measures crushed paddy, 10 measures Indian Bran, 1 measure crushed gram, gives 5·4 lb. paddy, 4·5 lb. Bran, 1·49 lb. Gram—total 11·69 lb., (or per month, a bag and a half paddy (108 + 54 lb.), a bag and a half Indian Bran, half bag gram), yielding 10·99 Food-Units, against 10·44 Food-Units yielded by 10 lb. oats, with a nutrient ratio similar to Australian Oats, and costing Rs. 25·50 in Colombo, which with straw, shoes, muthu, grass, salt and repairs comes to a total stable account of Rs. 50-52 per month.

A. BRUCE.

DURA BREAD.

In Egypt, the Sudan, and other parts of Africa, where dura *(Sorghum vulgare)* is largely grown, it is the staple food of the people. It is also used for feeding cattle and poultry, and for a variety of other purposes. Its possible uses in Europe have been dealt with already in this Bulletin (1911, 9, 253; 1913, 11, 33); in the present note it is proposed to deal with its use for bread making. In a pamphlet published recently by the Ministry of Agriculture, Egypt (EGYPTIAN AGRICULTURAL PRODUCTS, No. 1A, p. 22), and dealt with more fully subsequently in this Bulletin (p. 482), an account is given of the preparation of dura bread in Upper Egypt, where this crop is the chief source of flour. For bread making it is almost always used in combination with either wheat, barley, fenugreek, or even beans.

In an article in L'AGRICOLTURA COLONIALE (1915, 9, 217) a summary is given of experiments in bread making with dura that have at various times been carried out in Italy. Results of experiments in which dura was used alone and in admixture with wheat in various proportions are tabulated, and analyses are given of bread made with dura, and with various mixtures of dura and wheat; in comparison with those of bread made from wheat and other cereals. Analyses are also given of dura flour prepared from the grain produced in various countries, together with corresponding figures for the flours of wheat, rye, maize, and barley. These figures show the high nutritive value of dura, and are of special interest at the present time in view of the high prices of wheat and cereals generally.

Bread made from dura flour with an admixture of 25 per cent. of wheat flour had all the desirable qualities of good bread; its taste was excellent, and superior to that of bread made from wheat flour in admixture with rye, rice, or potato flours. Bread made from dura flour alone was of excellent quality and taste, and had several points of superiority over bread made from rye or maize. Such bread made by European methods is of course quite different from the dura bread made by the methods in vogue in Egypt and in other parts of Africa.

The cultivation of dura in Italy in place of maize has been suggested, and has been tried already on an experimental scale. The chief objection to this crop is its late ripening, but it is anticipated that this disadvantage may be minimised by limiting its cultivation to the southern parts of the country or by planting comparatively early-ripening varieties; it is also hoped that improvements may be effected in this and other respects by means of selection.—IMP. INST. BULLETIN.

WEED KILLERS.

E. CRIVELLI.

In treating of the so-called plant poisons, the writer deals with the various methods for the destruction of weeds.

Many American farmers use a 5 per cent. solution of copper sulphate or a 15 per cent. solution of ferrous sulphate to destroy weeds growing with cereals; a single spraying destroys most of the weeds in a few days, without any damage to the crop.

In tropical countries, where the luxuriant growth renders the upkeep of railways particularly costly, resort is had to arsenical mixtures to keep the tracks free from weeds. A liquid of this type used by a South American Railway Company consists of white arsenic 72 gms., caustic soda 15·5 gms.,

phenolphthalein sufficient to give an intense colouration, water to make up to 100 cc. This solution diluted 1 in 10 is sprayed over the whole width of the track by means of special trucks attached to the end of goods trains, at the rate of about 1 quart per square yard. During the first it is repeated every three months, then every six months. The Columbia and Eucador Railways have adopted a liquid composed of equal volumes of a 17 per cent. solution of nitrate of soda and a 20 per cent. solution of arsenious acid.

In Europe this treatment is only required on roads paved with cobbles and on walks in gardens and parks. The writer has experimented in such places with sodium sulphide; though dearer, this is more practicable near habitations. Sodium sulphide has also been suggested for the sterilization of soil before sowing. This method was then adopted in the United States, using cheaper barium or calcium sulphide in place of the sodium sulphide. Considerable quantities of the sulphides of the alkaline earths are in common use in the United States for destroying noxious weeds in the soil.

In a recent patent by L. CHEESEMAN (U. S. A., No. 1076818, October 20, 1913), the sterilization of the soil is effected by means of a mixture of barium sulphide and quicklime. A patent by BELLANGER (France, No. 433159, August 10, October 26, December 17, 1911) comprises a mixture of barium sulphide (25 parts), barium aluminate (50 parts) barium chloride (25 parts). Another patent (U. S. A., No. 1070808, August 19, 1913) proposes the treatment of furrow slices with a mixture of anthracene oil and humus.

A fertilizing and fungicidal powder patented by FONTAINE (France, No. 433127, November 1, 1910, November 4, 1911, January 15, 1912) has the following composition :—Flowers of sulphur 6 parts, potassium chloride 5, superphosphate 5, quicklime 55, sulphate of iron 20, water sufficient to slake the lime. Another mixture with the same object was patented by DOKKENWADEN (France, No. 389729, April 29, July 7, September 10, 1908) and consisted of 452 pounds of saturated solution of sodium nitrate, 22 pounds of potassium chloride with 72 tons of absorbent matter (wood pulp, etc.) or else 880 pounds of superphosphate with 116 tons of marl, the whole mixed with raw petroleum or phenol at the rate of 44 pounds per ton. There is also a powder devised by MATHERON (France, No. 336117, October 29, 1903, February 29, 1904) for the destruction of weeds consisting of a mixture of copper sulphate and ferric chloride, with a salt of salicylic acid : it is used in solution of 20 to 30 pounds per 100 gallons, at the rate of about 90 gallons per acre.—BULLETIN OF FOREIGN AGRIC. INTELLIGENCE.

SCIENCE AND EDUCATION.

SIR RONALD ROSS refers in SCIENCE PROGRESS to the papers read by PROF. JOHN PERRY and PROF. ARMSTRONG at the British Association Meeting and after quoting from the latter to the effect that "Science must be organised as other professions are organised if it is to be an effective agent in our civilisation," goes on to say :—"There are really two points at issue in these papers, first the general British disinclination for scientific work and thought, and secondly, the rejection of science in education. Everyone deplores the former defect, but we do not see clearly how it really depends upon the latter. There has grown up an entirely unreal system of education—as unreal as "the square root of minus one," but as much loved by some people as is that mysterious entity or non-entity by others. Just as mathematicians make books out of their imaginary quantities, so do schoolmasters try to make men out of theirs—and in both cases the results are apt to be more curious than useful. We would be the last to object to a true classical education ; but then that education must always be combined with a scientific one. Unfortunately, what

the boy really receives is not a classical education at all, but a grammatical one —quite another thing. Nothing is more educative than a knowledge of the masterpieces of literature in all languages; but our youths do not receive any such instruction. It is doubtful whether many of them have ever even read through the Iliad so as to understand the wonderful construction and the wisdom of the great fable which it develops for the purpose of adding wisdom to mankind. This is not taught, but the boy is kept writhing on the gridiron of grammatical difficulties. Even with regard to English literature the masterpieces are not read by the boys in an intelligent manner, but are merely used for philological texts. The result is that few of our young people are even acquainted with the masterpieces of literature, and are certainly ignorant of their beauty and incapable of appreciating it. Thus when they grow up their minds are content with the most trifling fiction and the most puerile drama. Similarly, even in the teaching of mathematics, our boys are kept trifling in the porch—worrying over permutations and combinations or burrowing into the depths of conic sections, when they should be taken to the top of a mountain and be given a wide survey of the whole field. Thus they too are instructed only in the ground work, and remain for all their lives ignorant of the main meaning and scope of what was intended to have been taught to them. When we add to such negative teaching all the facts of nature discovered laboriously by many great workers, the square root of the sum results in the modern Briton—at least so far as his knowledge goes.

We do not wish to see any branch of knowledge removed from the curriculum. All knowledge is valuable: but we do not wish to see the receptive years of youth wasted upon unimportant knowledge when they might be used for the acquisition of important facts. The real fallacy of the schoolmaster is his supposition that education is valuable chiefly as an exercise and not as an opportunity for laying in stores of information. If this were the case, nothing should be more carefully taught in schools than the games of chess, which is perhaps just as good an exercise in many respects as are mathematics or classics. But the time of youth is short, and the opportunities soon vanish; and the boy kept trifling in the porch is apt, when he becomes a man, to leave it abruptly with some anger in his heart and without ever having entered the beautiful temple within."

Under the head of "pine-apple memos" the QUEENSLAND AGRICULTURAL JOURNAL gives the following information.

The returns from pine-apple cultivation on fair to good land fluctuate and vary from £35 to £80 per acre. The average yield of crop may be said to be 10,000 to 12,000 fruits or 10 to 15 tons per acre.

A man should be able to clear, manure and generally tend 10 acres or even more. It depends on the man, nature of soil and kind of labour (horse or hand). Intercrops, such as peas, beans, tomatoes, etc., may also be grown with pine-apples for the first year or two, but fertilisers must be employed to make good any deficiency thereby.

Naphthalene in a finely divided form is recommended as a soil fumigant. Used in the proportion of 1 cwt. per acre it keeps wire worm away, but for garden purposes about 1 lb. is used for every 8 or 10 square yards of soil. The Tokio Agricultural College found that for destroying nematodes the proportion of naphthalene need not exceed ·005 per cent. of the soil.

MEDICINAL PLANTS.

So long the Continent has been the chief producer of drug and medicinal plants, and this source has now been practically shut out by the war. The necessity therefore exists for the British colonies producing as much of the raw materials as possible, and in the JOURNAL OF AGRICULTURE, VICTORIA, we read of steps being taken toward this end. The Department of Agriculture, the Education Department and hospitals and schools are co-operating with a view to finding out what medicinal plants could be grown with success in Australia.

For the present, says the Journal, a number of plants are receiving attention, for which there is a considerable demand for medicinal purposes, viz.

1.	Aconite	*Aconitum Napellus.* Linn.
2.	Beech	*Fagus sylvatica.* Linn.
3.	Belladonna	*Atropa Belladonna.* Linn.
4.	Bitter or Seville Orange ...	*Citrus aurantium* var. *Bigaradia.* Hook F.
5.	Buchu, or Bucku ...	*Barosma betulina.* Bart and Wend
6.	Cascara Sagrada ...	*Rhamnus Purshianus.* D. C.
7.	Meadow Saffron ...	*Colchicum autumnale.* Linn.
8.	Foxglove	*Digitalis purpurea.* Linn.
9.	Gentian	*Gentiana lutea.* Linn.
10.	Golden Seal	*Hydrastis Canadensis.* Linn.
11.	Henbane	*Hyoscyamus niger.* Linn.
12.	Juniper	*Juniperus communis.* Linn.
13.	Licorice	*Glycyrrhiza glabra.* Linn.
14.	Lobelia	*Lobelia inflata.* Linn.
15.	Male fern	*Dryopteris (Aspidium) Felix-mas.* Schort.
16.	Opium poppy	*Papaver somniferium.* Linn.
17.	Peppermint	*Mentha piperita.* Smith.
18.	Broom	*Cytisus scoparius.* Linn.
19.	Senega	*Polygala senega.* Linn.
20.	Senna	*Cassia acutifolia.* Deble. *Cassia augustifolia.* Vahl.
21.	Stramonium	*Datura Stramonium.* Linn.
22.	Strophanthus	*Strophanthus Komle.* *Oliver*
23.	Dandelion	*Taraxacum officinale.* Wiggers.
24.	Valerian	*Valerian officinalis.* Linn.
25.	Viburnum	*Viburnum prunifolium.* Linn.
26.	American Wild Cherry ...	*Prunus serotina.* Linn.
27.	Witch Hazel	*Hamamelis virginica.* Linn.
28.	Anise	*Pimpinella anisum.* Linn.
29.	Castor Oil Plant ...	*Ricinus communis.* Linn.
30.	Camphor Tree ...	*Cinnamomum camphora.* Nees and Eber.
31.	Rhubarb	*Rheum officinale.* Linn.
32.	Lavender	*Lavendula vera.* D. C.

THE JOURNAL OF THE BOARD OF AGRICULTURE, England, prominently mentions Aconite, Belladonna, Dandelion, Foxglove, Golden Seal, Henbane, Poppy Datura and Valerian, as likely to be in demand.

SCIENCE FOR ALL.

The little attention given to science in education and in the public mind has been the theme of many essays and addresses. In both cases science is usually regarded as suitable for study by a select few only, and not as an essential part of all modern life and thought. Latin and Greek, history, and the literature of other times receive almost as much consideration now as they did before scientific discovery changed the whole aspect and outlook of life; and the mass of the people, as well as most of their leaders, are in their training deprived of light which should illumine the minds of all.

We do not for a moment suggest that the end of all education should be preparation for scientific careers; neither do we ask that men of letters, statesmen and administrative officers of departments of State should all be scientific experts. To make such claims would be unreasonable, though not more so than the accepted principle that familiarity with classical languages and literatures is a necessary qualification for such positions, and that the first place must be given to these subjects even if matters more closely related to modern conditions of existence in war or in peace have to be neglected. Our claim is that everyone—from elementary school pupil to college don—should be acquainted with appropriate outlines of scientific work and thought. We want science to be a part of every general education, and we urge that the times demand this recognition of its influence and potentialities. When this modernisation has been accomplished, facilities for scientific work will be increased a hundredfold, and the public will not be deceived by sensational announcements in the daily Press, or tolerate official indifference to the growth of natural knowledge.

It may be doubted whether the methods now followed in the teaching of scientific subjects in schools are as effective in creating or fostering interest in science as those formerly adopted. Twenty years ago or so, much more attention was given to the attractive side of science than is now the case. Pupils were shown interesting experiments or were encouraged to read about remarkable facts and phenomena in nature; and if they took a practical course they were able to cover a fairly wide field.

Personal observation, intelligent inquiry, quantitative tests are, of course, essential factors of scientific method, but we believe that to insist upon all school science being controlled by them is a mistake. The limited amount of time that is given to science in schools renders true research methods impracticable; and pupils in general can scarcely be expected themselves to possess the motive and the purpose that lead to scientific investigation. Every teacher knows that only rarely is a pupil capable of initiating an experiment or of arriving at a statement of law or principle from results obtained by practical work. Little justification can be found, therefore, for the concentrated attention given to a few subjects, with the view of imparting knowledge of experimental methods, when such a course means that the wonders of the fields beyond are kept outside the range of vision.

School science as at present taught, and as defined by examination syllabuses, seems to proceed on the assumption that every pupil is to become a skilful experimenter, or an original investigator, in the realms of Nature. Courses of laboratory work designed with this intention may not unfairly be compared with the test-tubing of former times, which aimed at making every boy an analytical chemist. The practical work now done is certainly more valuable as a means of scientific training than it used to be, but it may be doubted whether by such exercises science can claim a prominent place in the curriculum. Modern life requires that the elements of scientific method

and knowledge should form part of every educational course. School work should not be concerned in training experts in science, any more than specialists in classics, but with imparting the rudiments of a liberal education to all pupils, so as to awaken interest which will continue when schooldays are over.

That is the standard—abiding interest—by which successful teaching may be judged; and we are disposed to think that the descriptive and qualitative school science of a generation or two ago was better adapted to promote such continued attention than is the quantitative work in the narrow fields mapped out for instruction to-day. In their anxiety to impress pupils with a sense of scientific accuracy and cautious conclusion, advocates of the methods now in vogue have forgotten that it is even more important to present a view of science which shall be human as well as precise. To the general neglect of this aspect of scientific study, which appeals to all, must be ascribed the fact that science has lost much of its former popularity, and has become a task in which only a favoured few can hope to excel.

The achievements of science represent increase of knowledge, not alone for the man who makes it, not alone also for the nation or country to which he belongs, but for the whole human race. The conquests of science do not mean the aggrandisement of the country or people at the expense of another, but gifts to all who will receive them. The only domain which it is desired to penetrate is that of ignorance; and the fight is against the physical and mental death which is its heritage. Ignorance made plague the terror of Europe in the Middle Ages; science has proved that the disease is due to a bacillus which is conveyed by fleas from rat to rat, and from rats suffering from the disease to mankind. Ignorance ascribed malaria to a miasma or bad air arising from marshy places; science has shown it to be carried from one human being to another by a certain species of mosquito. Ignorance of the cause of yellow fever made the regions round the Caribbean Sea the White Man's Grave, where the risk of death for the visitor was greater than in battle; knowledge that the disease is communicated from an infected to a healthy person by the bite of a particular mosquito has been the means of converting the same places into tropical health résorts. One practical result of the discovery of the cause of yellow fever was that it made possible the construction of the Panama Canal. It was not a hostile army or political difficulties that obstructed the work commenced by DE LESSEPS, not mountain chain or desert waste, but an insect which raised a barrier of disease and death between endeavour and accomplishment.

We have in uplifting stories of this kind—and there are many others—plenty of themes for epics which rightly used, will stimulate interest in science, in both old and young. When a place for such literature is found in every educational course, the number of people who will follow scientific work with sympathetic minds will be greatly increased. At present school science means mostly determinations of specific heats or chemical equivalents, and similar exercises, while the deeds and thoughts which live giving interest to material studies are neglected altogether. We do not ask that science students only should be given much broader views of natural knowledge than can be acquired through laboratory manuals and class text-books, but that the historical and literary studies in all schools and colleges should include works in which great scientific achievements and generalisations are expounded. We are confident that such subjects can be made attractive to almost every mind, and that the want of general and intelligent interest in them is due largely to the neglect of descriptive scientific literature in all stages of instruction.

It is unfortunately true that men of science themselves are often interested in their own special field of work, and pay little attention to what

is being done in other directions. These are the days of specialised study, and though the high powers used for the eyepieces enable new details to be discerned, the field of view is greatly restricted in extent, and the sense of true proportion is lost. Specialisation is essential for advance, but when it also means indifference to external movements and influences, it does not represent the highest type of intellectual activity. We cannot urge with any force the desirability of bringing the laity to appreciate the outstanding points of scientific work if specialists in particular sections of such work manifest no interest in the results of investigations by their colleagues in other departments, or will not trouble to make themselves understood outside their own esoteric circle. Papers read before scientific societies are now so highly specialised that only occasionally can they be followed with intelligent interest by the whole of the fellows present at a meeting, and usually not more than two or three people are capable of criticising them. As this is the case in circles where at any rate the general language of science is understood, it is not strange that people who have not had a scientific education should believe that scientific description must be beyond their comprehension.

This belief is probably responsible for the fact that there is little demand for popular works on science and few large audiences for scientific lecturers. We can say without fear of substantial contradiction that in such an inspiring subject, for example, as astronomy, attempts at popularisation by books or lectures have less chance of success than they had fifty or a hundred years ago. We are well aware that there are a few individual exceptions to this generalisation, but the statement can be fully justified as a whole, not only as regards astronomy, but also by the experiences of most authors and lecturers in other branches of science. There has been a vast increase in periodical publications and general literature has been in the direction of text-books and treatises rather than in popular works, to which little encouragement is given, either by men of science or the public.

We should be sorry to suggest that scientific work is necessarily associated with poor literary style; indeed, we are sure that the literary compositions of men of science compare very favourably with those of other workers who are not purely men of letters. It may be doubted, however, whether sufficient encouragement is given to young scientific men to cultivate the power of clear expression, or whether sufficient appreciation is shown of efforts at making science intelligible to the people. An author like MR. H. G. WELLS, who creates wide interest in scientific work, is doing far better service to science than he would if he had concentrated his attention upon the minute biological structures of his early days as student and teacher. It would be greatly to the advantage of science if there were many more writers possessing like scientific knowledge with brilliant imagination and convincing pen.

Science can only secure its rightful position in a democratic State when its work and worth are widely known and understood. The makers of new knowledge can be trusted to continue to add to the stores already accumulated, but they should remember also that popular interest means increased support for their work and greater use of the results. It is rarely that great capacity for original investigation is combined with the gift of attractive exposition, and more rare to find both qualities being used for the popularisation of science, as, for example, in SIR RAY LANKESTER'S series of masterly notes and essays, three volumes of which have now been published. We believe the influence of such literary work upon the public mind is much greater than is generally understood, and we should like to see many equally attractive efforts of a similar kind in other scientific fields than those with which SIR RAY LANKESTER is most intimately acquainted.

The war has made people think of more serious things than those which had their attention a year or two ago, and there are signs that a more satisfying literature will be required than the light pabulum which has hitherto served What could be better adapted to provide for the coming need than the rich materials of science when attractively displayed? It is the privilege of scientific workers to have garnered these stores; and it is equally their duty to see that the nation does not perish for want of the stimulating food which they can furnish. If science does not come into its kingdom in the immediate future, it should not be for want of endeavour to enlighten the mind of the public and create intellectual interest in its aims, but because the people are content to be ignorant of the truths learned in the innermost courts of the temple of Nature, and to be without the power which such knowledge can give them.—NATURE.

THE IMPORTANCE OF LIGHT TO PLANTS.

The importance of light to the well-being of plants is thoroughly understood by gardeners. Daily experience shows them not only that plants must be exposed to light, but also that if the light which falls on the plant be below a certain intensity growth is checked. The reason for these facts is also well understood by practical growers, who have learned that plants require light in order to carry on the manufacture of their food. Only when light falls on them are the green parts of the plant able to construct from the raw materials—water and carbon-dioxide, which they obtain from the soil and air—the sugar which serves as an actual food material for the plant. Whether light is also necessary for the manufacture of the more complex nitrogen-containing foodstuffs, which the plant has also to make for itself, is not so certain.

What is certain, however, is that the effects of light on plants are by no means confined to this essential part in food-manufacture. As is well known, light is one of the great directive agents of plants. By its aid plants, like animals, find their way. That is to say, each leaf and stem and branch contrives to take up its proper position as a result of movements of adjustment in reference to the direction of the light which falls on that member. By means of this response to light ordinary leaves come to stand at right angles to the direction in which light falls on them.

In yet more subtle ways light affects the fortunes of plants. For example, it is well known that if the light which a plant receives be of insufficient intensity, although vegetative growth may continue the plant may fail to flower. Although the fact is known the explanation is not. It was suggested long ago that light of a certain wave-length (ultra-violet light) plays an important part in stimulating the development of flowers. Recent discoveries of PROFESSOR LOEB suggest that this old view may contain something of the truth for LOEB has shown that the eggs of certain animals (sea-urchins) begin to divide when exposed to ultra-violet light.

Another recent discovery which may perhaps lead to results of practical importance has reference to yet another effect of light on plant-growth. This discovery concerns respiration, the process whereby the plant (or animal) by bringing about the oxidation of its own substance—and particularly of the sugars which it has manufactured—obtains the energy whereby it does the work of living.

This process of respiration goes on unceasingly night and day in both plants and animals; but it has been known for some time that the rate of respiration, which is measured by the amount of carbon dioxide given off is definitely greater during the hours of sunlight than during darkness. The

most recent investigations have yielded what at first sight are remarkable and puzzling results. Thus it has been found that even though a plant be kept in absolute darkness (and in a constant temperature) the amount of carbon dioxide given off by the plant is greater during the day than during the night. The explanation of this curious fact is to be sought in the effect of sunlight on the oxygen of the air. The effect is termed ionisation, and it may be likened to that produced by a stonebreaker on a heap of stones. In unionised air the oxygen is composed of unbroken stones (molecules); when ionised, the oxygen consists of minuter particles which may be likened to the broken stones. These minuter particles of oxygen combine more steadily with the oxidisable plant substances than do the unbroken molecules, and hence the rate of respiration is increased. It would appear not impossible that practical advantage may be taken of this fact, and that by supplying them at night with ionised air the rate of growth of plants may be increased. The experiment, so far as we know, has not yet been tried, but if the facts described above are correct it is not impossible that "forcing by ionised air" may become a useful adjunct to the horticulture of the future.—GARDENERS' CHRONICLE.

SOME CROPS OF MANNAR.

COTTON.

This product is not heard of in this district nowadays. There are records of a cotton plantation undertaken by Government in 1802. MR. BOAKE (1888) records the introduction of New Orleans seed; a sample of the cotton grown was sent to Peradeniya but nothing seems to have resulted from it. Recently (1903) MR. DENHAM in his Administration Report records an experiment with cotton on some black soil in Vanni pattu, Nanaddan and Mantai, but the following Administration Reports do not give results.

The climate is admirable for cotton, but attempts should be directed to secure a variety that is a heavy yielder rather than the production of a very high staple. The cotton should be planted about the end of September or early in October and harvested in March or April. Maize and the sorghums will form a very good rotation, whilst very good pulses can be easily selected to suit the district. Under irrigation sugar cane should prove to be a very paying crop. I have seen some very fine juicy canes grown in the District.

TOBACCO.

This product is still grown in the District but the area is decreasing due, according to MR. DENHAM (Administration Report, 1903), to three factors: (1) "The supply was greater than the demand. (2) The Batticaloa cultivator can turn out the 'covering leaf,' for which Mannar tobacco was used, cheaper than the Mannar cultivator. (3) A decline in the demand for Jaffna cigars, due to the increase in cigarette smoking." MR. BOAKE writes thus about tobacco. "The cultivation of this 'naughty Indian weed' seems to have been carried on from a very early period, and to have gained a reputation for strength of quality. It is still grown in considerable quantity, and I have smoked cigars made of it, which in strength and flavour surpass even the best Dumbaras, and are infinitely preferable to most of the Indian and Burmese cigars I have tried. The only thing against them is that the leaf is insufficiently fermented, and the make is atrocious" (Mannar—A monograph. 1888).

The area under tobacco varies yearly from 100 to 250 acres. It is cultivated chiefly in Illuppaikodavai, Attimoddai, and Vidattaltivu, but now coconut plantations are being made on good tobacco land. The cultivating season is from December to April and cultivators from Jaffna migrate to these centres at this time.

COCONUTS.

The acreage under this product is increasing. It is believed that early in the nineteenth century there was a large area under coconuts. At present there are about 3,500 acres under coconuts. The nature of the soil limits the extension of coconut plantations to the coastal strip; further inland the soil or subsoil is a stiff clay and is unfavourable for the growth of the palm.

PALMYRAH.

The area under this product is decreasing. An interesting method of cultivation for the young palmyrah roots is practised annually; the plants are dug up when about a few months old and the hard starchy roots *(Kilangu)* are sold. This forms part of the food of the poorer classes who make cakes with the pounded flour, jaggery and toddy.

HENRY L. VAN BUUREN (JR.).

THE COMMON CROW.

Many of our present criticisms of this bird, as its pulling corn, feeding on ripening ears, damaging fruits of various kinds, destroying poultry and wild birds, and disseminating diseases of live stock, were common complaints in the days of the early colonists. Many of the virtues of the crow, now quite generally recognized, also have been matters of record for many years. In recent times, however, scientific study of these problems, including the examination of the stomachs of hundreds of crows secured in every month of the year and under a variety of conditions, has enabled us to render a much fairer verdict than was formerly possible.

The crow is practically omnivorous. During spring and early summer any form of insect life seems to make a desirable item in its diet, and in winter when hard pressed nothing in the animal or vegetable kingdoms which contains a morsel of nutriment is overlooked.

The insect food of the crow, which comprises about a fifth of its yearly sustenance, does much to atone for its misdemeanours. Grasshoppers, May beetles and their larvæ (white grubs) caterpillars, weevils, and wireworms stand out prominently. In 1,103 stomachs examined these highly injurious forms comprised over 80 per cent. of the insect food. Grasshoppers are naturally taken in great abundance late in the season, September being the month of largest consumption, when they form about a fifth of the total food. May beetles and white grubs are eaten in every month except January, but occur mostly in May. In June caterpillars are a favourite food, and weevils of various kinds are taken in varying quantities throughout the summer and fall. About half the remaining 20 per cent. of insect foods is composed of beneficial ground beetles, ladybirds, predacious bugs, and parasitic wasps, and related forms, the rest consisting of neutral or injurious forms. Numerous instances are on record where fields badly infested with white grubs or grasshoppers have been favourite resorts of crows, whose voracity has resulted in a material suppression of the pest. When the amount of food required to sustain the individual crow is considered, the work of these birds appears all the more important. Single stomachs containing upwards of fifty grasshoppers are not uncommon. Thus in its choice of insect food the crow is rendering an important service to the farmer.

In the other animal food of the crow are several items of the utmost economic importance. Spiders are taken in considerable numbers in May and June, but the yearly total is a little over one per cent. of the food. In early spring crawfish are eagerly sought, and other aquatic food as fish and molluscs lend variety to the crow's bill of fare the year round. In the consumption of

toads, salamanders, frogs, and some snakes, which together comprise a little over two per cent. of the yearly food, the crow is doubtless doing harm. Small rodents occurred in the stomachs collected nearly every month, but it is often difficult to determine whether small mammals found in birds' stomachs were taken alive or found dead.

From its carrion-eating habits the crow has been unfairly criticised as a disseminator of live-stock diseases. While this may be to some extent just, the fact that there are many other important carriers which lie largely beyond our control, shows that we must seek final relief only through the strictest methods of sanitation.

The nest-robbing habit of the crow, long a serious criticism, is verified by stomach analysis. Fifty of the 1,103 crows examined had fed on wild birds or their eggs, and the eggs of domestic fowls were found slightly more frequently. The crow's habit of rummaging about garbage piles may explain much of this latter material.

Of the vegetable food, corn, which is eaten every month, is the most important item and forms about a third of the yearly diet. Much of this, however, must be considered waste. Over 60 per cent. is consumed from the 1st of November to the end of March. During the periods when corn is sprouting and when in roasting-ear stage the crow is eating this grain at a rate considerably less than the yearly average, and the months of smallest consumption are July and August. At times, however, the damage to corn becomes a serious problem, and were it not possible to make use of such deterrents as coal-tar upon seed corn there would be little friendship for the crow in some sections of the east. The "pulling" of corn is a trait most prevalent in small field areas. Wheat and oats suffer similar damage at times, especially in the north-western states, where these grains predominate. About the only safeguard to ripening grain is the constant use of powder and shot or the scarecrow.

Various kinds of cultivated fruits also are eaten, and local damage to such crops as apples, melons, peas, beans, peanuts, and almonds is occasionally reported. In long, rigorous winters, the crow, like other birds, resorts to the fruit of numerous wild plants, as dogwood, sour gum, hackberry, smilax, and the several species of sumac and poison ivy.

Damage to the eggs of poultry may be reduced to a minimum by careful housing of laying hens, and the farmer can protect his sprouting grain to a large extent by the use of tar-coated seed. It will be well also to keep the crow within reasonable numbers on game preserves and public parks where it is desired to encourage the nesting of smaller birds. While legal protection is not needed for so wary an individual as the crow, it seems well, where local conditions have not aggravated particular shortcomings of the bird, to allow it to continue the good services rendered to man in the destruction of noxious insects.—BULLETIN OF FOREIGN AGRIC. INTELLIGENCE.

THE MANUFACTURE OF SOAP.

S. G. SASTRY.

Soap manufacture is a chemical industry. The fats and oils, which receive in the industry the generic title of Soapstock, may be either of animal or vegetable origin. Chemically they are all glycerides of the higher fatty acids, chiefly of stearic, palmitic, oleic, and lauric acids, with some others of less importance. All fats and oils yield soaps when treated under suitable conditions with caustic alkali. It is the purpose of this paper to make a brief study of the manufacture of soaps.

In an industry the situation of a factory is of very great importance. Nearness to the raw products, a constant and steady supply of labour,

facilities with regard to fuel and water, communications by railways and by sea in connection with the import of raw materials and the export of the finished product—these are some of the main points to be considered. Bangalore seems to be a place eminently suited for this purpose, being a very important railway centre, and also having an abundant supply of water, and of fuel also in the casuarina plantations in the District. The conditions of labour also are very satisfactory.

In all well managed concerns it is the quality of labour that is of primary importance. Expert labour is always necessarily costly but in the long run it is much more paying than cheap and unprofessional labour. Since in all chemical industries there are a lot of unseen and preventible losses, high class and professional labour will reduce such losses to a minimum. Efficiency is the main point to be aimed at and cost of labour is of secondary, but still very important, consideration. The skill of the manufacturer consists in getting expert men at as low a price as possible. Much care and thought have to be bestowed to ensure a careful selection of employees in the factory. In England in most of the celebrated soap factories, before entering a firm's employment both boys and girls must have passed the sixth standard and have attained the age of 14. MESSRS. J. CROSSFIELD & SONS, LTD., Warrington, who are one of the largest manufacturers of soap in the world, make it compulsory upon all boys and girls in their employment between the ages of 14 and 17, to attend an evening school at least three nights a week. The course of instruction for boys is naturally concerned with questions relating to their special line of work. Girls are taught domestic economy, etc.

Even though it seems difficult to attain the same state of affairs at Bangalore, for the majority of the employees at least, it seems to be the best policy to fix the lower Secondary Examination as the test to be passed before they can be admitted into such a factory for any responsible work.

COST OF PRODUCTION.

It is essential to success in the soap industry to-day not only to obtain the raw materials cheaply, but also to use them economically and efficiently in the way discovered to be the best research experiment. The commercial prosperity of many a firm to-day depends on the policy of its technical staff of experts. Experiments should be constantly made and patient research conducted and the results obtained applied for the economic production of the desired articles. While conducting experiments in the laboratory the sense of proportion is lost, and though valuable indications may be obtained by working with one or two pounds of the materials, still they will have to be modified considerably to suit the factory conditions, and in all flourishing soap factories it is usual to have small experimental plants, where the results of the laboratory research are first tested before being adopted for use in the factory on a large scale. The hardening of oils and fats *(hydrogenation)* is one of the best examples of what chemical research can do in a soap factory.

It is a trite point to mention that the raw materials should cost as little as possible. But often it is found to be more advantageous to have a dearer raw material. A cheaper quality fat, if bought, may have to be bleached and deodorised, and on account of these things the cost of production may go up very much. Before passing on to the next subject it is worth while to note that the appearance of the finished product will have a great deal of influence on its selling properties, as in all other kinds of business. For example, a certain section of the Indian customers desire to have transparent soaps. Another variety of soap having superior merits with regard to lathering power and detergency, if it does not possess the same standard of transparency, will not appeal to the eyes of that section of the customers, and consequently will not "sell" to the same degree as an inferior article,

simply because the latter has the bright, trim and transparent look that the public demands. In a similar manner, a perfect soap, if only in a shapeless lump, will not "catch" the market as much as a nicely trimmed and attractively shaped tablet, wrapped in a piece of tissue paper, and then neatly packed in boxes. All these things increase the cost of production, but the public demands it, and a successful manufacturer caters to the public taste.

There is another interesting fact to be carefully considered in connection with the cost of production. Now-a-days all important soap concerns in any country will have their own "causticising" plants—I mean that they buy the sodium carbonate and lime, and then prepare the sodium hydroxide or caustic soda from them in their own establishments. This method is on the whole a very economical one, and even though, in its early stages, a soap factory started in Bangalore may buy caustic soda from the Western countries, eventually at least the soap factory will have to have its own alkali plant.

There is ample scope for alkali industry in India. In the Mysore State, with a plentiful supply of electricity, there seems to be no reason why an enterprising man should not start to make caustic soda and bleaching powder, by the electrolysis of common salt. But this is a digression from our subject.

It is often remarked that the degree of civilization of any country can be found out by the amount of soap consumed in that country, On this principle, India is only gradually getting civilised in the eyes of many people, although these when they apply the doubtful principle to India, quite naturally forget that there are many excellent substitutes for soaps, which are being used extensively all over the country. But still it may be confidently said that the demand for soaps is increasing day by day and this steady demand should prove the prosperity of any soap manufacturing concern started on a sound basis. Toilet soaps are in great demand and at present it is for cheap toilet soaps; household soaps hold the market next; textile soaps have only a very limited sale. A toilet soap with quick lathering power and also a good detergent, which can be sold anywhere between three to four annas per tablet of the recognised popular size, is bound to hold the market and sell very well. Such a soap would presumably contain rosin.

MACHINERY.

In all well managed concerns only well designed plants will be used; because crude plants, even though they may not cost much at the beginning are much more costly in the long run than are well designed plants. As for the size of the plant, in all manufacturing concerns there is always an economic size of the plant to give the maximum product at a minimum cost. This is to be determined upon by taking all the aspects of the business into consideration. This is rather a ticklish job to settle, because many things that are extremely well paying on large scale productions will not be paying at all on a small scale production.

In many cases low cost on capital consideration is essential; and if additions are to be made, they are not to be introduced until 20 per cent. per annum on the improvement is ensured in the return. Also the cost of the improvement should be recovered within two years of introducing the improvement. It is very important that an Indian manufacturer should bear in mind while purchasing a plant the following points:—(1) The plant must be easy of control, (2) the ease and rapidity in making repairs, (3) the possibility of making temporary repairs while the plant is working, (4) the time lost in getting the plant into full swing of working order and also the time lost in shutting down the plant after the work is finished.

For a very small soap works, with a modest output of five tons of soap per week, the following things are necessary:—One soap copper, one tallow and oil melting tank, one caustic melting tank, one caustic, tallow and soap pump, lye tank, ten soap frames, two hand crutches, one slabbing frame, one

barring machine, one hand stamping machine, drying room fittings, and pipes and connections between the above parts,

With a greater output all the above things are to be in larger sizes and some of them in greater numbers. Steam-driven crutches may be used. If the spent soap lye is to be treated a glycerine-refining plant is to be added to the above list.

It is only in very large works that soap cooling machines, power driven stamping machines, etc., can be used. In smaller works humbler devises should prove their use.

KINDS OF SOAP.

According as the soap is hard or soft, it consists of the sodium or potassium salts of a mixture of higher fatty acids. These are in the case of a hard soap stearic, palmitic, myristic, lauric, oleic acids, and to a less degree caproic, caprylic, capric, arachidic, and erucic acids, In the case of a soft soap, these are chiefly oleic, linolic and linolenic acids. Since the sodium salt of rosin possesses valuable detergent properties, many well-known brands of household soaps contain rosin also. Even though the household soap and also the cheaper brands of toilet soaps may contain rosin, it is to be considered as an adulterant in high class toilet soaps. Many cheap varieties of washing soaps contain what is technically known as "running" or "filling." For this purpose sodium carbonate and sodium silicate are used in varying proportions, and enable the soap to carry more water. To go into more details on the composition of soap would not interest the general reader. So we pass on to consider the next subject.

RAW MATERIALS.

The raw materials consist of oils and fats and caustic alkali. If soap stock fatty acids are used then sodium carbonate may be used instead of caustic soda. The soaps prepared from different oils vary in their properties to a very great extent and hence in practice to obtain a soap of any desired quality various oils and fats are blended. At the present day the chief oils and fats that are used in soap making are tallow, lard, palm-oil, coconut oil, palm kernel oil, arachis oil, soya bean oil, castor oil, cotton seed oil, olive oil, linseed oil and, although neither a fat or an oil, rosin.

Many of these oils can be obtained in Mysore in sufficient quantities, and the above list may be supplemented with honge oil and dhup-seed oil. From the examination of the physical and chemical properties these two oils promise to be excellent soap stock. Honge oil possesses a characteristic smell which is not permissible in soaps. An economic method of deodorising is to be found out and the oil treated properly before use. Another drawback for the use of this oil is the high percentage of unsaponifiable matter. An improved method of obtaining the oil may remove this drawback to a certain extent at least. Dhup-seed oil can act as an excellent substitute for tallow and palm oil. Its titre is 54·8°C. It seems to have a high acid value which can be guarded against by bestowing some care in its method of preparing. There is another interesting fact recorded about this dhup-seed, namely that it contains to the extent of 2 per cent. a pleasantly smelling volatile oil which can be extracted with alcohol. It may be worth while to investigate the problem further and find out the commercial possibilities for this volatile oil.

The only other chief raw materials required are caustic soda, sodium carbonate, sodium silicate, common salt and rosin, with some others of less importance. Perfumes—both natural and synthetic—are required for toilet soaps.

It was mentioned earlier in this paper that the oils and fats are to be blended in order to give a soap of any desired quality. It would be clearer if an example were taken. Suppose we had to manufacture a household soap which can be used for washing clothes—suppose also that we had at our disposal cotton seed oil, coconut oil, tallow and rosin. Cotton seed oil by itself would give a soft, slimy and greasy soap, white when fresh and apt

to become rancid and yellow on drying. The soap is very difficult to salt out even with much sodium cholride added to the pan and the soap retains a high percentage of water. The soap would not lather well. Coconut oil on the other hand if used alone would give a white, hard, brittle, noncurdy soap if salted out well. The soap dissolves in water and even in weak brine; lathers easily and freely, but the lather is not persisting. The soap can hold large quantities of water and "filling" and still remain hard. Rosin (neither an oil nor fat) gives a thin soft sticky soap; can be "*killed*" either by caustic soda or sodium carbonate. The soap is devoid of body but is an excellent detergent. Finally tallow would give a white hard soap, dissolving but slowly in water. It lasts well in use, and lathers well but with difficulty.

If instead of using any of them separately, all the four were blended in certain proportions and then saponified (rosin is conveniently saponified separately and the resulting product added to the soap pan in the final stage) we ought to get a fine soap possessing all the properties desired. In fact the recipe for one of the well known brands of the household soaps imported to India from England, seems to be 25 per cent. of each of the materials named above. Substituting dhup-seed oil for tallow, and possibly honge oil for cotton seed oil, any manufacturer in Mysore should be able to produce an excellent household soap second to none now on the market, and should be able to compete with others.

PROCESS OF MANUFACTURE.

We now come to the actual process of manufacture. The whole process for the purpose of clear understanding may be represented diagramatically as on the accompanying page.*

A mixture of purified oils and fats is boiled with a solution of caustic soda in steam heated pans holding anything from five to one hundred tons of soap. Formerly these pans used to be manufactured in cylindrical shape, with a tapering bottom. But the most modern plants have a rectangular shape with rounded corners and with a tapering bottom. For equal capacities the rectangular shape will effect a saving of 25 per cent. of floor space, which is a very important consideration in many factories.

During the process of saponification the oil or fat is attacked by caustic soda, resulting in the formation of soap and glycerine. After the saponification is complete a solution of common salt (sometimes the dry salt itself) is added to the pan. This results in the formation of two distinct layers in the pan, one of them being the soap, which is insoluble in brine, and the second layer consists of what is technically known as "the glycerine lye." This latter contains common salt, glycerine and other impurities associated with the raw materials used. This glycerine lye is drawn off from the bottom of the pan by means of taps and sent to the glycerine refinery for further treatment. The soap that is now left in the pan is mixed with rosin soap, and then boiled once more with a "strengthening" charge. After this the half-spent lye is drawn off and the soap "fitted." The process of "fitting" consists in boiling the soap with open steam until the desired degree of closing of the grains of soap is attained. In some cases the fitted soap is allowed to settle for four to six days. On subsidence the contents of the pan will have divided into the following:—(1) on top, a thin crust of soap, with perhaps a little light coloured fob; (2) the good soap containing 62-63 per cent. of fatty acids; (3) a layer of darker weak soap termed "nigre" which on an average contains about 33 per cent. fatty acids; (4) a solution containing alkaline salts. It is the second layer that forms the good soap. The first layer is taken out and put back into another pan before saponifying a fresh charge of fats. The nigres are utilized in various ways.

After completion of the saponification, and allowing the contents of the pan to settle into layers, as described in the previous section, the good soap forming the second layer is transferred into frames. The thin crust or layer

* Not reproduced.

at the top is gently removed, and the good soap is ladled out and conveyed to frames or withdrawn by the aid of a pump from above the nigre through a skimmer and pipe, attached by means of swivel joint to a pipe fitted in the side of the pan; or the removal may be performed by gravitation through some mechanical devise from the side of the "copper." Of course every precaution is taken to avoid the presence of the "nigre" in the soap.

CRUTCHING.

The next thing to be done is crutching. This consists in stirring the hot soap in the frames by means of hand crutches until the temperature is sufficiently lowered and the soap begins to assume a "ropiness." Crutching may also be done in power driven, steam-jacketed crutches. These are cylindrical in shape, with a tapering bottom preferably, and steam jacketed for the sake of convenience. They are provided in the middle with a "stirrer" or an "agitator," which may be of any convenient form—either a vertical or horizontal shaft carrying several blades, or the agitator may take the form of an Archimedean screw. As mentioned in the previous sections, soap is placed in frames and allowed to cool for a certain number of days. As far as one can see the old method of cooling slowly in frames requiring several days, must under the pressure of modern competition die out. There seems to be only three good reasons why the old method has lasted so long. (1) The public estimates the amount of soap purchased by the size of the bar, not knowing that they are purchasing water at *3d.* per pound in some cases. (2) Partly dried soap does not dissolve in water as freely as the soap containing 30-60 per cent. of water. (3) Rapidly cooled soap is perhaps slightly inferior in texture and appearance to the one cooled slowly in frames.

SOAP COOLERS.

Before coming to a brief description of the different types of soap cooling machines, it is worth while to summarise the advantages and disadvantages of these modern soap cooling machines. By using these, one can avoid numerous cumbrous frames and the labour of handling them. There will be a great deal of saving in space. The rapidity of the conversion of finished soap into a saleable material means a great deal of saving, as the soap (=Capital) is not locked up for a long time. If the soap coolers have suitable dimensions—preferably capable of adjustment—then the bars and roads or slabs of soap may be cut up without any scraps being left over. An order can be carried out rapidly and the material delivered very quickly, if none in stock. The method of cooling under pressure is specially suitable as the soap slabs are then brighter and firmer and hence the soap may be richer in rosin and filling than would be possible if the soap is merely "cast" in the candle mould type of machine.* Therefore less solid fat and more liquid fat may be used. As all the ordinary soaps can thus be treated, except the cold process and mottled soaps, it may be confidently predicted that the old way of cooling in frames is doomed to extinction before long at all events in large works where a large variety of soaps are made. (Soft soaps are naturally out of the question in this connection.)

As against all these may be said that the cost of soap cooling machines is rather high; but this off-sets the cost of a number of frames. Some soap cooling machines can only make one kind of bar or slab which means a different machine for each size. Soap cooling machines require more skilful workmen than ordinary frames. As yet the public are not yet educated up to seeing that the product from the rapid cooler is just the same essentially as it would be if put through an ordinary frame, although it differs somewhat in appearance, texture and hardness, owing to difference in the rate of cooling. Of course, it rests with the manufacturer to convince the buyer that such soaps can do the same work as economically as the older make.

* In this the advantage scarcely rests with the consumer, but that is quite a different point.

Since the subject of soap cooling machines is a very important one in this industry, we cannot pass on without giving a brief description of the types of different machines now in vogue. All these are essentially the same in the fundamental principle of rapidly chilling thin layers of soap by means of cold water, in opposition to the old way of cooling in soap frames. CRESSONNIERE'S were the pioneers and their plant is largely used for toilet soaps. The soap flows into a jacketed mixture (colour may be added here advantageously), thence through a series of rolls cooled by water circulating in them, and afterwards passes in thin films over a series of endless gauze bands in a box warmed by steam pipes and fitted with a blower to renew the air. The soap leaves the box after about ten minutes holding about 10 per cent. of water, and ready for milling, etc. Another machine in use is the SCHNETZER-SCHICHT. It is best described as being built like a candle machine, i.e., the soap is cooled in water jacketed cylinders worked at 12-atmosphere pressure. Cooling water at 10-12°C and soap at 80°C it turns out 100 bars of soap weighing 3·3 lb. each (1·5 kilos) in 30 minutes per batch. Three men work two machines. Water required is only 0·5 cubic meter per 100 kilos of soap. JACOBI'S Cooler is built on the filter press model. It consists of a large steam jacketed pressure vessel, from the bottom of which a jacketed pipe leads to the cooler which consists of a number of wooden frames lined with polished nickel. These frames are sandwiched between hollow plates with polished nickel surfaces, cooled by a current of water, each plate having its own supply. Soap is admitted to the plates from below, air escaping from a small hole at the top of each. When filled compressed air at three atmospheres is put on to the pressure vessel and kept on till the soaps are solidified. Time required is about 40-50 minutes. The last two machines are slightly discontinuous, but on the whole give larger outputs. A continuous process has been suggested in which the soap is driven in a zig-zag direction vertically by a series of worms worked by gearing upwards and downwards alternately. The mass of soap is cooled externally by a water jacket, and internally by water passing through the axis of the worm. It passes directly into a plodder.

All the above are simple, occupy little space, save labour, increase output greatly and lower costs, especially interest on capital (soap) locked up in soap frames. Waste is also greatly reduced.

FINISHING PROCESS.

Before the soap is finally cut into slabs, bars and tablets, sometimes it will be necessary to add the various "fillers," and this is best performed in the crutchers to which reference has already been made. The bars are then cut into tablets, which are stamped in a machine. This machine is worked by hand, and is meant for stamping the bars into twin tablets or other form and is the one most used in all soap factories, except in those cases where automatic mechanical stampers are employed in particularly big works. This is the ordinary procedure for all household soaps. The manufacture of toilet soaps, however, is a little more complicated. In this case the soap which ordinarily contains 30-33 per cent. of moisture, is solidified on water cooled cylinders (one of the soap cooling machines described previously) and dried in hot air stoves until the moisture is reduced to 10-12 per cent. Subsequently it is milled between massive granite rollers in order to make it thoroughly homogeneous and smooth, and to allow the colour and perfume (synthetic and natural) being blended in order to suit the requirements of the market. The soap saturated with scent is now in "ribbons" and is ready to enter a machine called the "Plodder." This machine, by means of an Archimedean screw, squeezes the shreds of soap through a nozzle into a homogeneous whole, delivering it in the form of one continuous bar, of the particular shape required. This bar is cut and shaped into tablets, which after receiving some finishing touches by hand, are packed neatly in attractive boxes.—THE MYSORE ECONOMIC JOURNAL.

MARKET RATES FOR TROPICAL PRODUCTS.

(From Lewis & Peat's Latest Monthly Prices Current.)

	QUALITY.	Quotations.
ALOES, Socotrine cwt.	Fair to fine	40/ a 50/
Zanzibar & Hepatic ,,	Common to good	40/ a 70/
ARROWROOT (Natal) lb.	Fair to fine	5d
BEES' WAX cwt.		
Zanzibar Yellow ,,	Slightly drossy to fair	£7 10/ a £7 15/
East Indian, bleached ,,	Fair to good	£8 10/a £8 12/6
,, unbleached ,,	Dark to good genuine	£6 5/ a £7
,, Madagascar ,,	Dark to good palish	£7 15/ a £8 2/6
CAMPHOR, Japan lb.	Refined	1/7 a 1/8
China cwt.	Fair average quality	155/
CARDAMOMS, Ticuticorin	Good to fine bold	5/9 a 6/
per lb.	Middling lean	4/8 a 5/4
Malabar, Tellicherry ,,	Good to fine bold	5/9 a 6/3
Calicut ,,	Brownish	3/9 a 5/3
Mangalore ,,	Med Brown to good bold	4/ a 6/4
Ceylon, Mysore ,,	Small fair to fine plump	4/ a 6/4
Malabar ,,	Fair to good	3/2 a 3/4
Seeds, E. I. & Ceylon ,,	Fair to good	4/ a 4/3
Ceylon "Long Wild" ,,	Shelly to good	2/3 a 3/6 nom.
CASTOR OIL, Calcutta ,,	Good 2nds	3½d
CHILLIES, Zanzibar cwt.	Dull to fine bright	50/ a 60/
Japan ,,	Fair bright small	60/ a 70/
CINCHONA BARK.—lb.	Crown, Renewed	3⅜ d a 7 d
Ceylon	Org. Stem	2d a 6d
	Red Org. Stem	1¾ d a 4½d
	Renewed	3d a 5¼d
	Root	1⅝d a 4d
CINNAMON, Ceylon 1sts.	Good to fine quill	1/3 a 1/9
per lb. 2nds.	,, ,,	1/2 a 1/7
3rds.	,, ,,	1/1 a 1/6
4ths.	,, ,,	1/ a 1/3
Chips.	Fair to fine bold	2d a 4d
CLOVES, Penang lb.	Dull to fine bright pkd.	1/ a 1/2
Amboyna ,,	Dull to fine	10d a 10½d
Zanzibar ,,	Fair and fine bright	5¾d a 6¼d
Madagascar ,,	Fair	7d
Stems ,,	Fair	2d
COFFEE		
Ceylon Plantation cwt.	Medium to bold	Nominal
Liberian ,,	Fair to bold	63/ a 80/
COCOA, Ceylon Plant. ,,	Special Marks	81/ a 88/6
	Red to good	73/ a 80/6
Native Estate ,,	Ordinary to red	42/ a 68/
Java and Celebes ,,	Small to good red	30s a 93s
COLOMBO ROOT ,,	Middling to good	15/ a 22/6
CROTON SEEDS, sifted ,,	Dull to fair	42/6 a 47/6
CUBEBS ,, ,,	Ord. stalky to good	130/ a 150/
GINGER, Bengal, rough ,,	Fair	19/
Calicut, Cut A ,,	Medium to fine bold	75/ a 85/
B & C ,,	Small and medium	35/ a 74/
Cochin, Rough ,,	Common to fine bold	22/6 a 27/
	Small and D's	20/
Japan ,,	Unsplit	20/
GUM AMMONIACUM ,,	Ord. Blocky to fair clean	40/s a 72s 6d
ANIMI, Zanzibar	Pale and amber, str. srts	£14 10/a £16 10
,,	,, ,, little red	£11 a £12
,,	Bean and Pea size ditto	70/ a £11
,,	Fair to good red sorts	£8 10/ a £10 10
,,	Med. and bold glassy sorts	£5 10/ a £7 5/
Madagascar ,,	Fair to good palish	£4 a £8
	,, ,, red	£4 a £7
ARABIC, E. I. & Aden ,,	Ordinary to good pale	26/ a 32/6
Turkey sorts ,,	,, ,,	37/ a 57/6
Ghatti ,,	Sorts to fine pale	17/ a 27/
Kurrachee ,,	Reddish to good pale	22/6 a 32/6 nom.
Madras ,,	Dark to fine pale	20/ a 30/ nom
ASSAFŒTIDA ,,	Clean fr. to gd. almonds	£6 a £6 10/
	com. stony to good block	40s a £5
KINO lb.	Fair to fine bright	6d a 1/5
MYRRH, Aden sorts cwt.	Middling to good	57/6 a 67/6
Somali ,,	,, ,,	52s 6d a 55s
OLIBANUM, drop ,,	Good to fine white	45s a 50s
,,	Middling to fair	35s a 40s
pickings ,,	Low to good pale	15/ a 27/6
siftings ,,	Slightly foul to fine	18s a 25s
INDIA RUBBER lb.	Fine Para smoked sheets	2/4
	Crepe ordinary to fine	2/2
Ceylon, Straits, ,,	Fine Block	2/4½
Malay Straits, etc. ,,	Scrap fair to fine	1/8 a 1/9
Assam ,,	Plantation	1/10
,,	Fair 11 to ord. red No. 1.	1/3 a 1/6
Rangoon ,,	,, ,, ,,	1/2 a 1/4

	QUALITY.	QUOTATIONS.
INDIA RUBBER lb.		
Borneo ,,	Common to good	9d a 1/3
Java ,,	Good to fine red	1/3 a 1/6
Penang ,,	Low white to prime red	9 d a 1/4
Mozambique ,,	Fair to fine red ball	1/9 a 2/1
,,	Sausage, fair to good	1/9 a 2
Nyassaland ,,	Fair to fine ball	1/9 a 2
Madagascar ,,	Fr. to fine pinky & white	1/4 a 1/6
,,	Majunga & blk coated	1/ a 1/2
,,	Niggers, low to good	6d a 1/6
New Guinea ,,	Ordinary to fine ball	1/4 a 1/7
INDIGO, E.I. Bengal ,,	Shipping mid to gd. violet	3s 3d a 3s 8d
,,	Consuming mid. to gd.	2s 9d a 3s 2d
	Ordinary to middling	2s 4d a 2s 9d
,,	Mid. to good Kurpah	1s 11d a 2s 5d
,,	Low to ordinary	1s 6d a 1s 9d
,,	Mid. to fine Madras	1/11 a 2/9
MACE, Bombay & Penang	Pale reddish to fine	2/4 a 2/6
per lb.	Ordinary to fair	2/ a 2/2
Java	,, ,, good pale	2/ 1 a 2/4
Bombay	Wild	1/
NUTMEGS,— lb.		
Singapore & Penang ,,	64's to 57's	9½d a 10½d
	80's	7½d
	110's	6½d
NUTS, ARECA cwt.	Ordinary to fair fresh	17/6 a 20/
NUX VOMICA, Cochin	Ordinary to good	13/6 a 15
per cwt. Bengal	,, ,,	12/
Madras	,, ,,	12/ a 13/
OIL OF ANISEED lb.	Fair merchantable	5/2
CASSIA ,,	According to analysis	2/8 a 2/11
LEMONGRASS oz.	Good flavour & colour	2¼d
NUTMEG ,,	Dingy to white	1½d a 1⅞d
CINNAMON ,,	Ordinary to fair sweet	4d a 1s 5d
CITRONELLE lb.	Bright & good flavour	1/6½
ORCHELLA WEED—cwt		
Ceylon ,,	Fair	10/6
Madagascar ,,	Fair	10/6
Zanzibar ,,	Fair	10/6
PEPPER—(Black) lb.		
Alleppy & Tellicherry	Fair	5d
Ceylon ,, ,,	Fair to fine bold heavy	5d a 5⅝d
Singapore ...	Fair	4⅝d
Acheen & W. C. Penang	Dull to fine	5d a 5½d
(White) Singapore ,,	Fair to fine	8½d a 8¾d
Siam ,,	Fair	8½d
Penang ,,	Fair	7⅞d
Muntok ,,	Fair	9d
RHUBARB, Shenzi ,,	Ordinary to good	2/ a 4/
Canton ,,	Ordinary to good	1/10 a 3/6
High Dried ,,	Fair to fine flat	11d a 1/1
	Dark to fair round	9 d a 10d
SAGO, PEARL, large—cwt	Fair to fine	18/
medium ..	,, ,,	16/
small ..	,, ,,	13/ a 14/
Flour ..	Good pinky to white	10/ a 11
SEEDLAC cwt.	Ordinary to gd. soluble	65/ a 75/
SENNA, Tinnevelly lb.	Good to fine bold green	5d a 8½d
	Fair greenish	3d a 4½d
	Common specky & small	1½ d a 2½d
SHELLS, M. o' PEARL—		
Egyptian cwt.	Small to bold	72/6 a £6
Bombay ,,	,, ,,	85/ a £6 10/
Mergui ,,	Chicken to bold	£8 12/6 a £145
Manilla ,,	Fair to good	£7 17/6 a 13 10
Banda ,,	Sorts	50/ nom.
Green Snail ,,	Small to large	70/ a 85/
Japan Ear ,,	Trimmed selected small to bold	47/ a £5 15
TAMARINDS, Calcutta...	Mid to fine bl'k not stony	14/ a 15/
per cwt. Madras	Inferior to good	6/ a 10/
TORTOISESHELL—		
Zanzibar & Bombay lb.	Small to bold	12/ a 26/
	Pickings	6/6 a 19/
TURMERIC, Bengal cwt.	Fair	12/ a 13/
Madras ,,	Finger fair to fine bold	14/ a 16/
Do. ,,	Bulbs ,, ,, [bright	12/ a 13/
Cochin ,,	Finger fair	13/ nom.
	Bulbs ,,	11/6 a 12/
VANILLOES— lb.		
Mauritius ... } 1sts.	Gd. crystallized 3½a 8½ in.	9/6 a 15/
Madagascar ... } 2nds.	Foxy & reddish 3½a ,,	9/ a 12/
Seychelles ... } 3rds.	Lean and inferior	9/ a 9/6
VERMILLION ... lbs.	Fine, pure, bright	2/7
WAX, Japan, squares cwt.	Good white hard	47/6

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